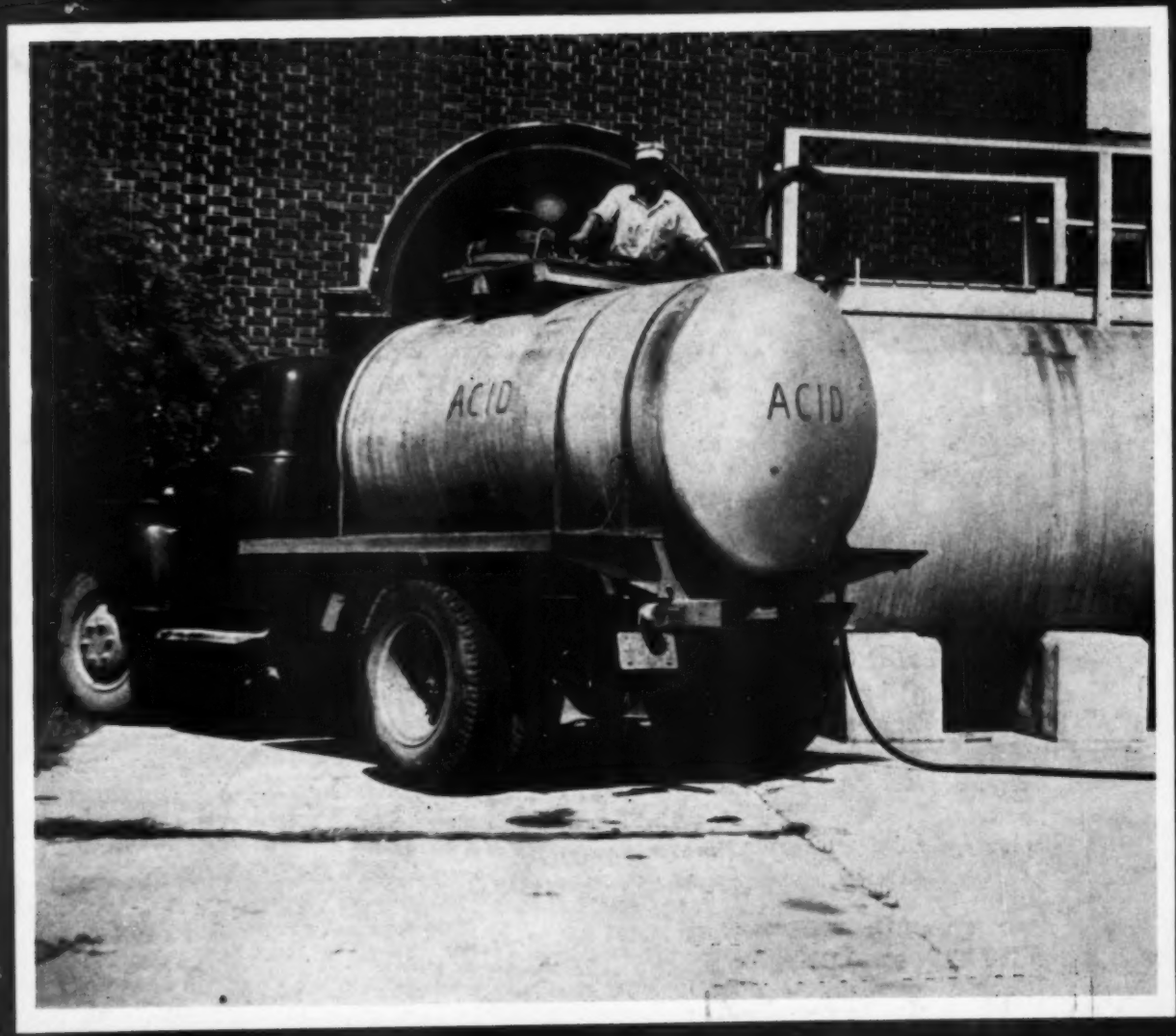
WATER & SEWAGE WORKS

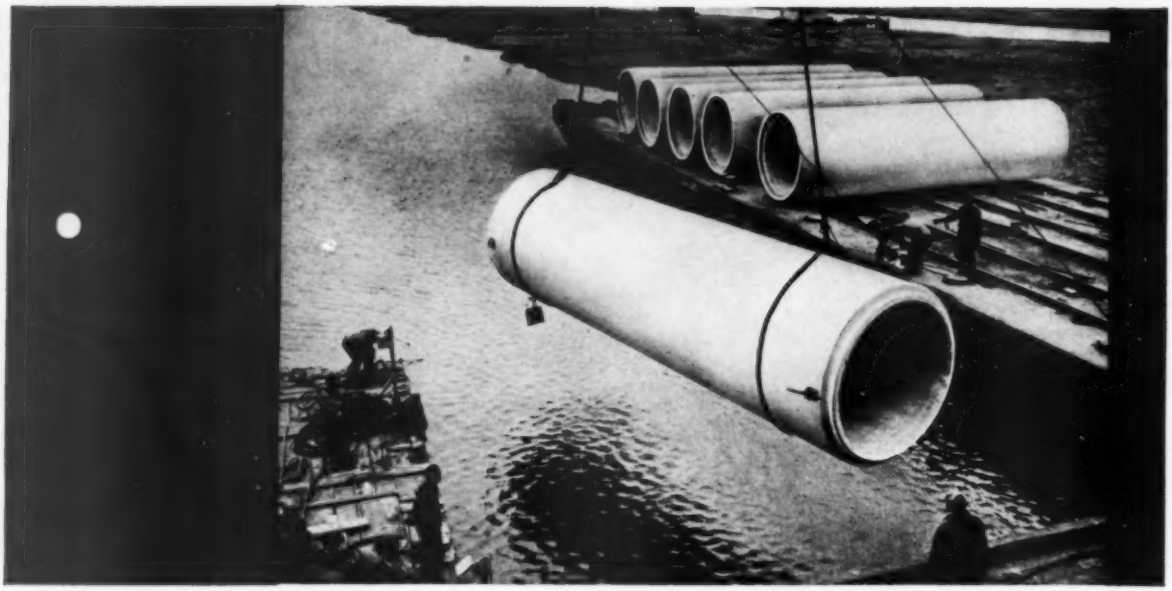
WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL



NOVEMBER 1954

LOCK JOINT

for efficient and easy subaqueous installation



Ideal for water intakes, sewer outfalls and river crossings, Lock Joint Reinforced Concrete Subaqueous Pipe provides the simplest, most effective method of joining pipe under water. The self-centering Rubber and Steel joint can be drawn together accurately and easily by merely taking up the nuts on two draw bolts of a special joint harness. Once the joint has been pulled "home," the compressed rubber gasket seals a permanent, watertight, flexible joint which requires no further bolting, caulking or welding.

Added advantages of Lock Joint pipe are the absence of tuberculation or corrosion, long life, permanent high carrying capacity and minimum maintenance costs. If your pressure pipe project requires pipe 16" in diameter or larger, you owe it to yourself to investigate the unexcelled characteristics offered by Lock Joint.

One of the leading producers of sewer and culvert pipe, Lock Joint Pipe Co. also manufactures pressure pipe for:

- TRANSMISSION MAINS
- INDUSTRIAL INSTALLATIONS (Supply, circulating and cooling systems)
- DISTRIBUTION MAINS
- WATER WORKS OPERATIONS (Pumping and treatment plant piping)
- SEWER WORKS OPERATIONS (Force mains and treatment plant piping)

LOCK JOINT PIPE COMPANY

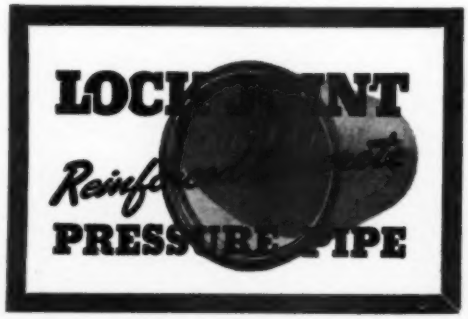
Established 1905

P. O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.

SEWER & CULVERT PIPE PLANTS:

Casper, Wyo. • Cheyenne, Wyo. • Denver, Col. • Kansas City, Mo. • Kennett Square, Pa. Valley Park, Mo. • Chicago, Ill. • Rock Island, Ill. • Wichita, Kan. • Kenilworth, N. J. Hartford, Conn. • North Haven, Conn. • Tucumcari, N. Mex. • Oklahoma City, Okla. • Tulsa, Okla. • Beloit, Wis. • Hato Rey, P. R. • Ponce, P. R. • Caracas, Venezuela • Wholly Owned Subsidiary, Great Lakes Pipe Co., Plants: Buffalo, N. Y. • W. Henrietta, N. Y.



Let a HOMELITE do it...

Every time you need pumping, the handiest, fastest-operating pump you can find is a Homelite Gasoline Engine Driven Pump.

Small and compact, your Homelite fits snugly in the smallest truck. *And when needed* . . . one man picks it up and carries it easily to any place where needed.

Quick starting . . . fast self-priming . . . (a Homelite starts pumping instantly) at the rate of 15,000 gallons per hour. Yes, and when it comes to seepage, a Homelite keeps it right at strainer level always, automatically.

Non-clogging, weatherproof, dustproof . . . and with a guaranteed suction lift of 28 feet . . . a Homelite carryable pump will give you years of dependable service, on even the toughest jobs.

Write for a free demonstration.

Manufacturers of Homelite
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PERFORMANCE · DEPENDABILITY · SERVICE

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CORPORATION

711 RIVERDALE AVENUE • PORT CHESTER, N. Y.

HOW TAYLORVILLE SOLVED ILLINOIS' HARDEST WATER PROBLEM

Since 1888, hardness of up to 974 ppm had wasted soap, left sticky curd on dishes and clothes, formed scale to clog pipes, *wreck* water heaters.

After World War II, geologists found one of the best well-field sites in central Illinois. Hardness was about 200 ppm, still far too high to satisfy taxpayers, far-sighted city officials.

So when well-field contracts were awarded, the project included a modern *water softening* plant. Consulting engineers recommended Permutit equipment.

Taylorville's Precipitator (shown at left) reduces hardness, turbidity and alkalinity in a single, quick step. Its efficiency greatly reduces filter loads, cuts backwashing to a minimum.

This Permutit installation reduces hardness to the specified range of only 60-80 ppm (a mere 4 grains) . . . a far cry from Taylorville's old 974 ppm level!

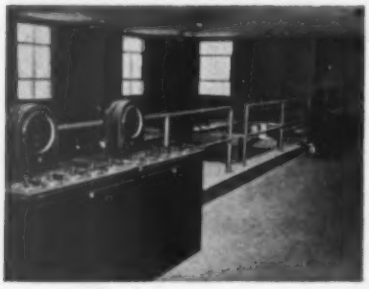
Permutit equipment can bring similar benefits to *your* city. Write today for information. The Permutit Company, Dept. W-11, 330 West 42nd St., New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS

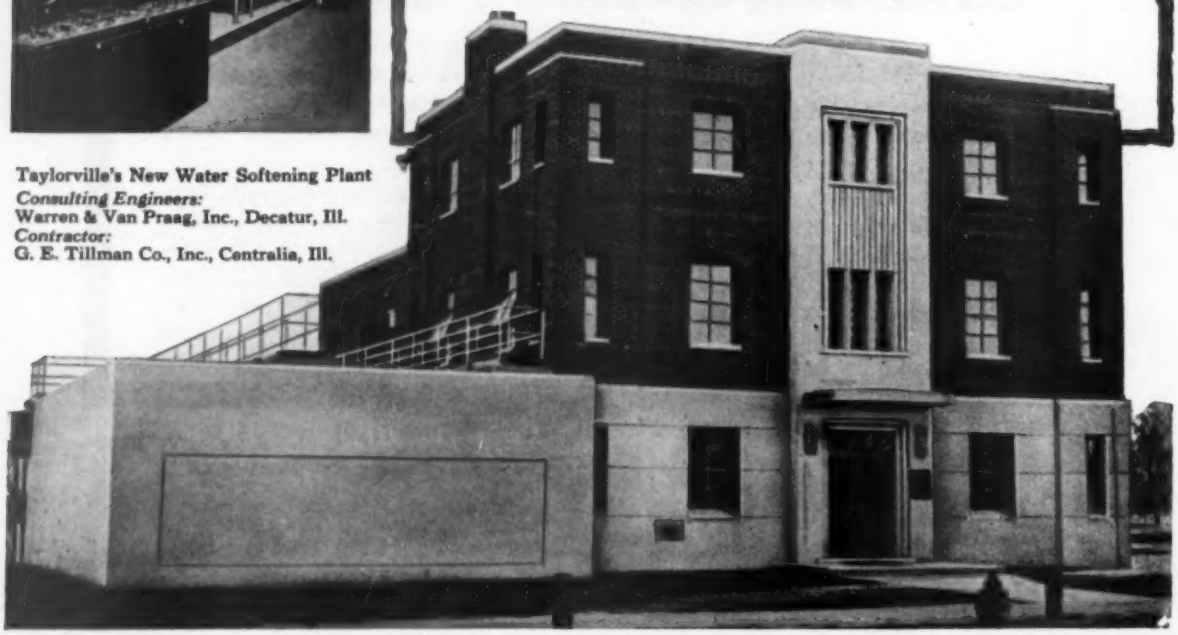
PERMUTIT®

Taylorville's 1500 gpm Permutit Precipitator. It softens and clarifies in *half* the space, ¼th the time of a settling basin.

Permutit Filters and Operating Tables assure crystal-clear water. Monocrete® Underdrain has cast-concrete headers and laterals to reduce costs.



Taylorville's New Water Softening Plant
Consulting Engineers:
Warren & Van Praag, Inc., Decatur, Ill.
Contractor:
G. E. Tillman Co., Inc., Centralia, Ill.



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WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

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How to protect the taxpayer against the *"WEAK LINK"*

Here's a timely message to the men responsible for the investment of tax dollars in sewage-works . . . the treatment plant as well as the sewer systems themselves.

Investing tax dollars in sewage works is a very real responsibility—shared by every city official, engineer and operator. These men know that two outstanding wasters of the taxpayer's dollar are exorbitant treatment costs due to infiltration and sewer-maintenance costs due to root growth.

Many cities fight infiltration and root growth successfully . . . up to a point. They install Transite® Sewer Pipe with the tight Ring-Tite® coupling for the street sewer lines. They know that, with Transite's tight joints, infiltration is sure to be kept far, far below the limits of even rigid specifications. And they know, too, that these tight joints lock out roots.

So far, so good. But such assurance does not go far enough—it goes *only up to a point!*

For there may be a "weak link" in this carefully planned program—the possibility that *the pipes which connect the homes to the street sewer* do not measure up to the standards of joint tightness set for the street sewers.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

This network of sewer lines is also important in planning

This network of building-sewer lines is very extensive. It equals or exceeds the footage of the main system, with the result that, unless these pipes, too, have tight joints, this building-sewer network may function as a vast underground drainage system. In areas of high ground-water table and during seasonal rains, this excess infiltration is collected and dumped into the street sewers. This overloads the treatment plant . . . adds to the cost of treatment and *defeats the very purpose of careful street-sewer and treatment-plant design.*

And, to make matters worse, joints which permit infiltration also open the door to root growth—again adding to the expense and trouble.

An important corrective step is being taken by many communities

Today progressive municipalities can take steps to make *every link* in the over-all sewer system a strong one. They can see to it, for example, that their codes specify, as do hundreds of codes throughout the country—the use of Johns-Manville Transite Building-Sewer Pipe. This assures in the building-sewer lines the same joint tightness provided by Transite Sewer Pipe in the city-street sewers.

You can take the immediate step of learning more about this asbestos-cement pipe with the tight joints that remove the weak link and give you the efficient, money-saving sewer system you plan it to be. Just fill out the coupon.

Johns-Manville, Box 60, New York 16, N. Y.

Yes, let me have some of the facts about Transite Building-Sewer Pipe, the strong asbestos-cement pipe with the tight Ring-Tite Coupling.

Name_____

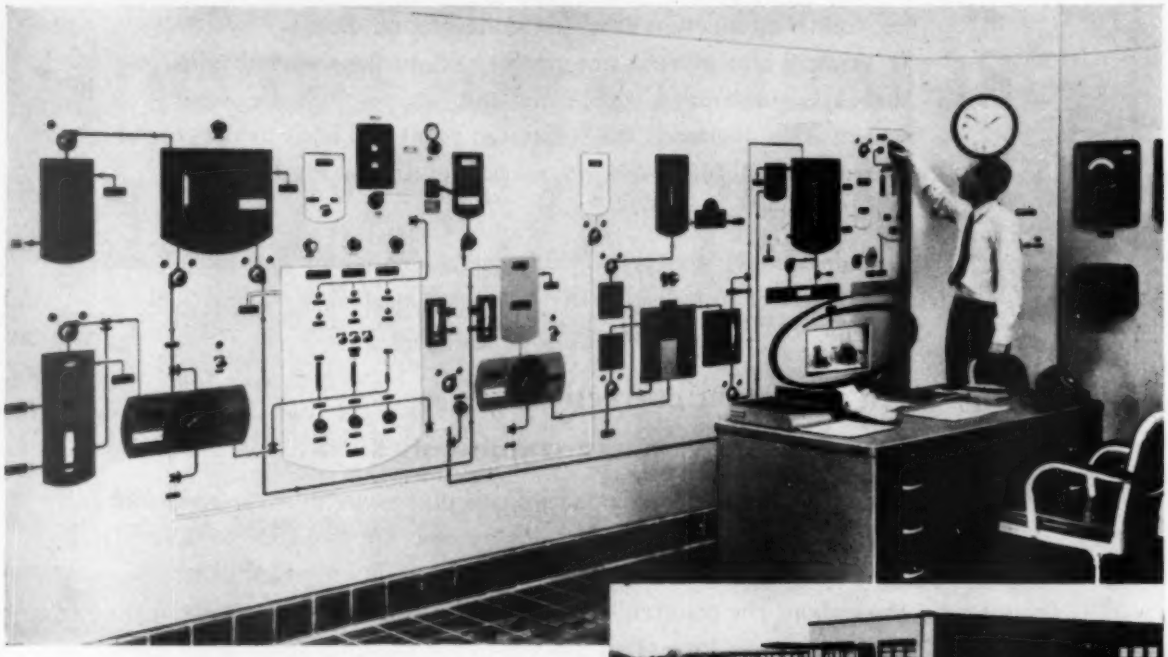
Address_____

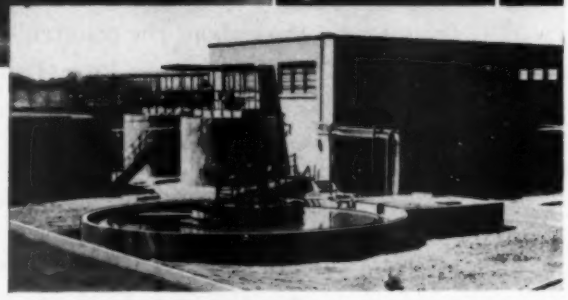
City_____ State_____

TRANSITE PIPE

Oneida, Ltd.*

keeps waste quality "fit for a fishbowl"!





Single operator at Foxboro Graphic Control Panel (above) directs combined batch and continuous processes in this ultra-modern waste treatment plant at Oneida, Ltd., Sherrill, N. Y. Alkaline and acid wastes, containing oils, cyanides, and dissolved metals are made completely safe for discharge into tiny, nearby, Sconondoa Creek. *Consulting Engineers: Westcott & Mapes, New Haven, Conn.*

. . . unique Foxboro centralized system automatically controls treatment – runs "sample" through aquarium!

There's living proof that modern waste treatment techniques under Foxboro Automatic Control completely remove the "toxic threat" from plating wastes at Oneida, Ltd., Sherrill, N. Y. Goldfish and plants flourish in an aquarium through which a sample portion of the clear, treated effluent continuously flows!

This "fishbowl check" is the end-point on the Foxboro Graphic Control Panel which gives one operator complete command of the $1-million treatment plant. Foxboro Instrumentation automatically controls such functions as flow, level, chlorine dosage, and oxidation tank transfer . . . makes 20,000 g.p.h. of complex wastes completely safe for aquatic life.

Foxboro Control Systems are continually solving similar waste problems . . . recovering valuable by-products . . . increasing use of re-circulated water . . . building better public relations. Write for complete information on instrumentation for your disposal problem. **The Foxboro Company, 8911 Neponset Ave., Foxboro, Mass., U.S.A.**

FACTORIES IN THE UNITED STATES, CANADA, AND ENGLAND

*Manufacturers of Community Silverplate and Heirloom Sterling

FOXBORO
Reg. U.S. Pat. Off.

Automatic Control for Waste Treatment

Ore and Coal Mines

Coke Ovens

an integrated operation gives assurance plus of pipe quality

Blast Furnaces

Pipe Plants

U.S. PIPE

U. S. Pipe and Foundry Co. is a wholly integrated producer of cast iron pressure pipe with our own mines, quarries, coke ovens and blast furnaces.

Thus we have complete and undivided control of every step in the production of basic raw materials used in making U. S. Cast Iron Pipe. Our integrated operation starts literally from the ground up.

In addition to being able to control the quality of pipe-making raw materials at their sources, our Quality Control of pipe production gives further assurance to customers that the quality level of U. S. Cast Iron Pipe is in excess of standard specifications. Our pipe is produced to our own quality control specifications, more exacting than the established specifications under which cast iron pipe is normally purchased.

U. S. PIPE & FOUNDRY COMPANY

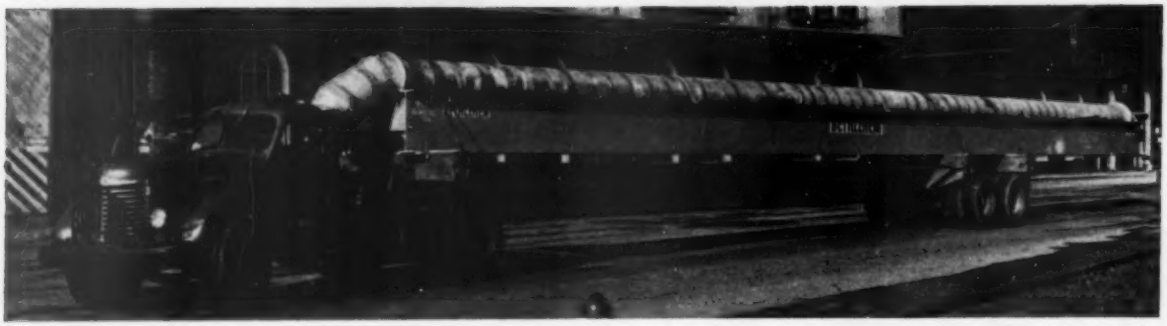
GENERAL OFFICES: B'RMINGHAM 2, ALABAMA

A wholly integrated producer . . . from mines and blast furnaces to finished pipe.

Bethlehem Steel Pipe On The Job

IN FORT SMITH, ARK. — Nearly 12,000 feet of 22-inch Bethlehem Tar-Enameled Pipe was used in the new feeder main that supplies a fast-growing section of Fort Smith.

NEAR DECATUR, GA. — Laying well over four miles of 30-inch coated and wrapped Bethlehem Steel Pipe. The 40-foot lengths were joined by mechanical couplings.



PHILADELPHIA, PA. — Shown being trucked from our Steelton, Pa., fabricating works, this all-welded H-Beam pipe bridge will span a railroad right-of-way in suburban Philadelphia. The pipe is 24 in. ID; the bridge is 83 ft long between field seams.

The list of municipalities using Bethlehem Tar-Enameled Steel Pipe is long — and getting longer all the time. It includes New Orleans, Cincinnati, Minneapolis, New York, Duluth, Washington, Omaha, Wilkinsburg, Pa., Bay City, Mich., Winston-Salem, N. C., and Colorado Springs, Colo.

When you're in the market for a new water or sewage line, we suggest that you consider the many advantages of Bethlehem Tar-Enameled Steel Pipe. It has the great strength, shock-resistance and freedom from leaks that only steel pipe can offer. What's more, its smooth, uniform coating of coal-tar enamel resists corrosion and incrustation, ensures a high rate of flow year after year. Available in 40-ft lengths, and in all diameters from 18 in. ID to the largest permitted by common carriers.

If you'd like more information, phone or write the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM *Tar-Enameled* STEEL PIPE

Those Who Use It... Choose It Again

MEMO

38.6% of all Hydrocranes Sold are Repeat Orders

Here the Hydrocrane digs a manhole. Every crane function is fully hydraulic — boom hoist, line hoist, swing, boom telescope, outrigger set and retract and bucket close.

Yes, 38.6 per cent of all Hydrocranes sold are additional machines bought by satisfied users. In fact, many owners are now fleet operators — buying a 3rd, 4th, 5th and even a 6th Hydrocrane! Here's real proof that this all-hydraulic truck crane produces big, gives owners an extra profit pay-off.

Only Hydrocrane gives you all these:

- ★ **"Reach-ability" with hydraulically telescoping boom.**
- ★ **Maneuverability with extremely short tail swing, low over-all height.**
- ★ **Stability with four hydraulically controlled outriggers.**
- ★ **Mobility with speeds up to 50 mph.**
- ★ **"Control-ability" with full hydraulic, finger tip control.**
- ★ **Convertibility — quickly changed to dragshovel front end in the field.**

Plus More for '54.

- ★ **Self-power — Hydrocrane has its own independent power unit. (optional)**
- ★ **Remote control — start it, drive it, turn it, stop it right from the crane cab. (optional)**
- ★ **Selector unit — foot control channels *extra* hydraulic fluid to line hoist bank— gives you 50% faster line speed. (optional)**
- ★ **Increased line speeds — even without selector valve unit, all line speeds are now 10% faster.**
- ★ **New pressure head — provides even better control of hydraulic pressure.**
- ★ **Increased crane rating — maximum capacity now 4-ton with two-part hoist.**
- ★ **Wrist-action dipper — makes Hydrohoe the only dragshovel with a triple action digging force . . . permits operator to vary dipper's digging postion.**

Arrange a demonstration now!

Compact Hydrohoe speeds trench job on city street. New wrist-action dipper provides variable digging angles . . . delivers extra digging power.

BUCYRUS-ERIE COMPANY
South Milwaukee, Wisconsin

Gentlemen:
Please send literature on
- ☐ self-powered and standard Hydrocrane
- ☐ self-powered and standard Hydrohoe
- ☐ remote control Hydrocrane-Hydrohoe
- ☐ wrist-action dipper
- ☐ I am interested in a demonstration

NAME_____
COMPANY_____
ADDRESS_____
CITY_____ STATE_____

47H54

Don't HIDE from the facts!

FACT: cast iron pipe lasts over 100 years.

FACT: cast iron pipe is inherently stronger, tougher, uniform in quality.

FACT: cast iron pipe offers a proven record of low installation and low maintenance costs.

FACT: cast iron pipe's long, trouble-free life saves millions of tax dollars.

FACT: cast iron pipe is the standard conduit for carrying water underground.

Before you experiment with substitutes in your waterworks system, study these facts and consider the guarantee they offer: that only cast iron pipe gives you a *proven record* of economy through *decades of use!*

AND ONE MORE FACT: for over three-quarters of a century, experienced city officials have found Clow Cast Iron Pipe offers consistent high quality. They've found Clow gives them excellent service and fast delivery. They know centrifugally cast Clow Cast Iron Pipe offers the greatest economy and it meets all currently approved specifications now in existence. Write today for more facts and actual case histories to learn how Clow Cast Iron Pipe offers you the best long-term investment.

JAMES B. CLOW & SONS

201-299 N. Talman Avenue • Chicago 80, Illinois

and their National Cast Iron Pipe Division, Birmingham, Ala.
Subsidiaries: Eddy Valve Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Iowa

CAST IRON

FAMOUS LIGHTHOUSES OF AMERICA

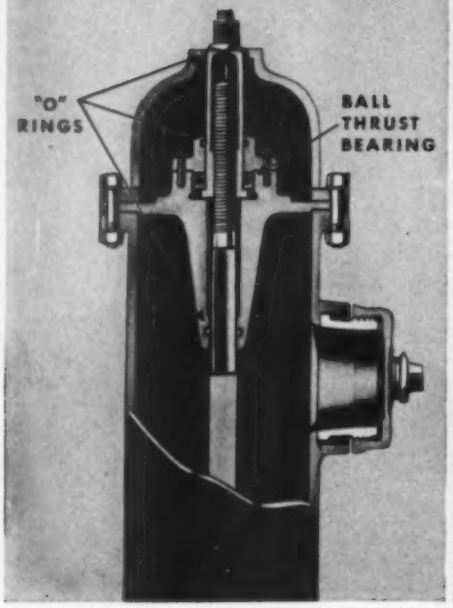
Mile Rock Light guards the south side of the channel leading through the Golden Gate into San Francisco Bay, one of the world's finest land-locked harbors. The lighthouse, built on top of Mile Rock, is constructed of steel and concrete upon a massive monolithic concrete base 34 feet high. The top of the beacon is 90 feet above mean low water. On the opposite side of the Golden Gate is Point Bonita Light.

Something to steer by for users of electrochemicals are the standards of quality and service set by Niagara Alkali Company. Many leading manufacturers depend, with the confidence of long experience, upon Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride)

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, N. Y.

TRADE
DARLING
MARK



A. W. Grathwol, manager of the Sandusky, Ohio, Water Distribution Department, checking static water pressure on a newly installed Darling B-50-B hydrant.

Word is getting around about DARLING'S NEW B-50-B FIRE HYDRANT

WATER distribution men like A. W. Grathwol of the Sandusky, Ohio, Water Distribution Department, are spreading the good news about the new patented Darling B-50-B fire hydrant. It rates as the most important fire hydrant advance in 50 years.

Here are reasons why . . .

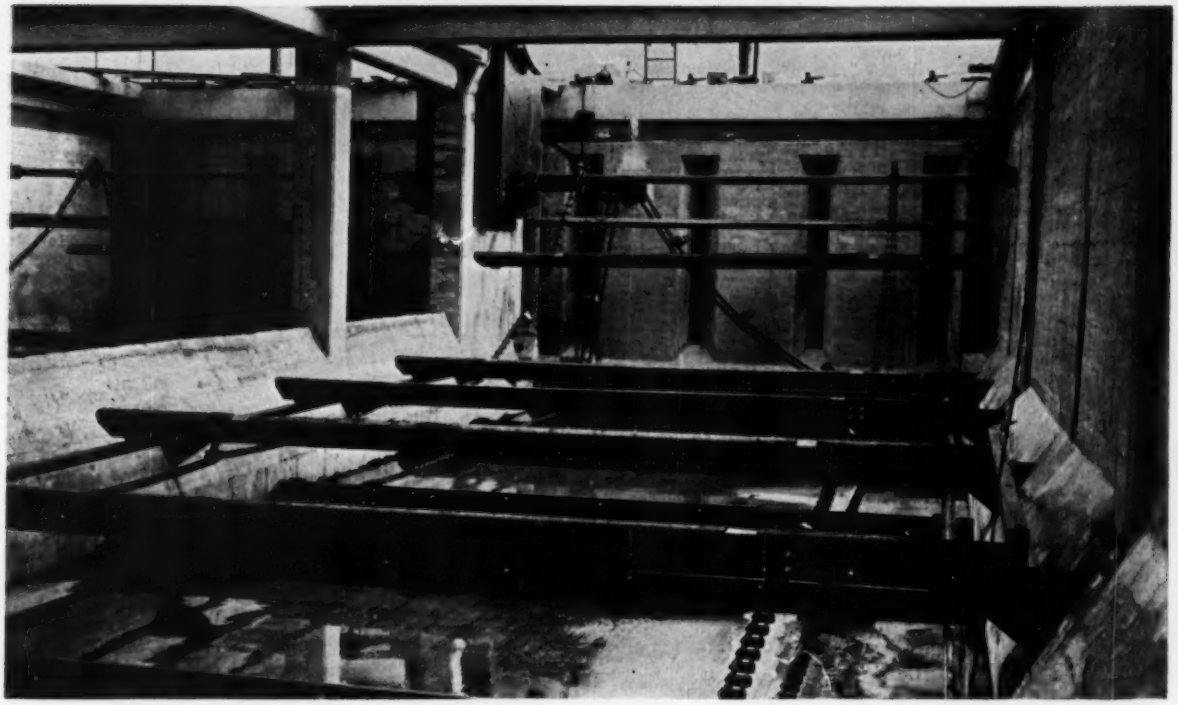
1. The "O" ring seals eliminate need for a stuffing box. Darling's B-50-B is a packless, *dry-top* hydrant that saves service time and trouble. It does away with bothersome packing gland adjustment and maintenance, assures constant lubrication of the operating threads *and prevents water from reaching the operating threads.*

2. The Darling B-50-B is a *ball-bearing* operated hydrant. Opening and closing takes less than half the usual wrench torque.

And you also get another long-time advantage of Darling hydrants . . . all inside working parts, including the main valve seat and drain valve seats, can be removed through the top *by one man* for on-the-spot inspection and maintenance. Write for Bulletin No. 5007 before you decide on any hydrant. Address . . .

DARLING VALVE & MANUFACTURING CO.
Williamsport 11, Pa.
Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ontario

Michigan City converts to mechanical flocculation and sludge removal



At Michigan City (Ind.) filtration plant, Link-Belt water treatment equipment has been installed in two existing tanks, and one new tank. Longitudinal and cross collectors can be seen in above photo of settling basins. Straightline mixers are installed in each of three flocculation basins. Link-Belt also furnished all drives (below). Consulting engineer: Boyd E. Phelps, Inc., Michigan City, Ind.

LINK-BELT Straightline Collectors abate lake pollution, reduce chemicals used in water treatment

FOLLOWING the trend by municipal filtration plants to reduce chemical dosage costs by mechanical flocculation and sludge collection, Michigan City, Ind., installed a Link-Belt Straightline mixer and sludge collector system. Immediate results included speed-up of collection and removal... elimination of the cost and inconvenience of periodic draining. And because slowly discharged sludge is easily assimilated by the adjacent lake, pollution is no longer a problem.

Link-Belt manufactures a broad line of sanitary engineering equipment—can meet any need from limited to complete modernization of a plant, large or small. Whatever your requirements, our sanitary engineers will be glad to work with your engineers, chemists and consultants—help you get the best in modern water, sewage or industrial liquids treatment.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

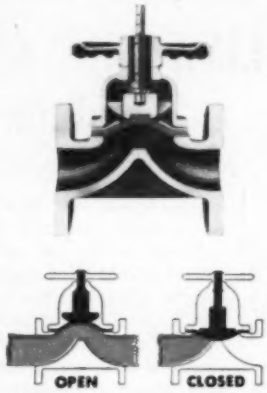
LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

13.547

GRINNELL-SAUNDERS DIAPHRAGM VALVES

In hundreds of installations, the maintenance-saving design of Grinnell-Saunders Diaphragm Valves has accounted for important economies of labor and money. The only part that will in time need replacement is the diaphragm, and depending on the type of service, it may last for years. To replace it takes only a few minutes. You merely remove the four bolts holding the bonnet, leaving the body in the pipe line . . remove the worn diaphragm, insert the new diaphragm . . replace the bonnet and bolt it down. No refacing or reseating required . . no packing glands to demand attention.

Originally perfected for air and water service, Grinnell-Saunders Diaphragm Valves are now widely specified for many other applications. They greatly reduce replacement and maintenance expenses, especially in lines where corrosion, abrasion, contamination, clogging and leakage can be costly factors. Write today for the Grinnell-Saunders Diaphragm Valve Catalog . . and assign your next valve problem to Grinnell.



Other Important Features:

Diaphragm absolutely isolates working parts from the fluid stream

Diaphragm lifts high for full, streamline flow in either direction

Diaphragm presses tight for positive closure

Body, lining and diaphragm materials to suit service

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

Don't let CORROSION put the bite on *your* Sewage Plant this year

PROTECT WITH PITT CHEM!

Don't underestimate sewage corrosion! It's a silent, insidious destroyer, on duty three shifts a day. It takes a tough, heavy film of protective material to give you sure, long-lasting protection against it. Sewage engineers all over the country are specifying *Pitt Chem* Tar Base Coating for the job. *Pitt Chem* is easy to apply, protects metal, masonry and concrete from sewage 7 to 10 years longer than ordinary paint, and its cost fits even the most nominal maintenance budget.

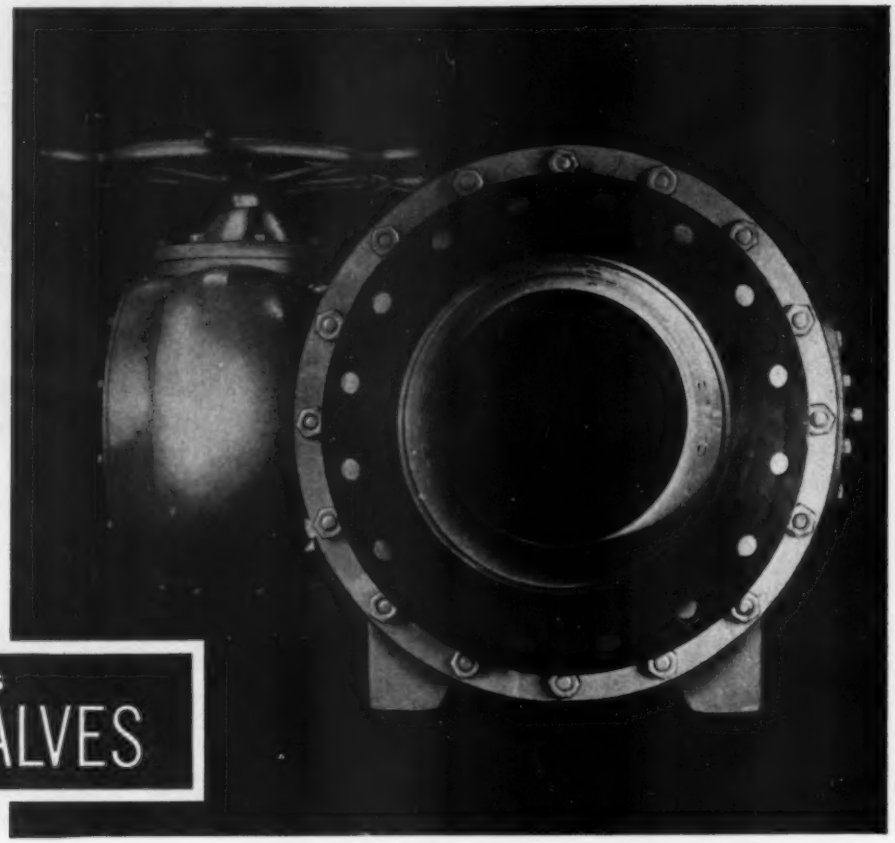
A *Pitt Chem* engineer will be glad to show you how you can protect your investment in sewage plant equipment . . . at a small fraction of the equipment's cost. Why not call for an obligation-free *Pitt Chem* survey today.

WBD 4996

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
PITT CHEM 110—Specialty Coating

PITTSBURGH COKE & CHEMICAL CO.

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON



SMS
BALL VALVES

a new achievement in valve performance . . .
STRAIGHT-THROUGH FLOW WITH DROP-TIGHT CLOSURE

For the path of least resistance—the new SMS-Ball Valve has no equal in design or price. When open, the valve is like a straight piece of pipe—nothing to resist flow and create resultant pressure drop, thereby reducing pumping costs. Elimination of turbulence adds to valve and pipe life.

EASE OF OPERATION—Forces required for opening and closing are remarkably low, even under adverse conditions. The tremendous leverage exerted by the operating mechanism affords complete ease of operation. Flow velocity tends to ease closing.

TIGHTNESS OF CLOSURE—Drop-tight closure is obtained by the wedging action of the metal-to-metal seats.

SMS-Ball Valves afford high performance at significant in-place savings. Costs compared to valves giving similar performance are appreciably less. Write for our new Ball Valve folder.

This new valve, as well as our full line of cone and butterfly valves, is backed by over 75 years experience in hydraulic design and research. For full information on your valve problem, check with your local representative, or write to S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines
Pumps
Gates & Hoists
Trash Rakes
Accessories

HYDRODYNAMICS

Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

S. MORGAN SMITH CO.

NEW
HORTON ELEVATED TANK FOR BARNWELL

The 150,000-gallon Horton® elevated tank shown at the left was recently installed as part of a municipal water works improvement program at Barnwell, South Carolina. New water mains and fire hydrants were also installed as part of the improvement program. Consulting Engineers on the project were Barber, Keels & Associates, Inc., Columbia, South Carolina.

If your municipal water system is carrying a heavy load that causes low distribution pressures and does not provide sufficient reserve of water for peak load periods and fire protection, Horton elevated storage may be the most economical answer to your problems. Horton ellipsoidal-bottom elevated tanks are built in standard capacities from 15,000 to 500,000 gallons—with radial-cone bottoms in standard capacities from 500,000 to 3,000,000 gallons. Write our nearest office for information, estimates or quotations on a Horton elevated tank of the right size and type for your needs. Chicago Bridge & Iron Company engineers will be happy to help you.

HORTON

WELDED STEEL

STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Greenville, Pa.

Atlanta 3	2181 Healey Bldg.	Los Angeles 17	1555 General Petroleum Bldg.
Birmingham 1	1586 North Fiftieth St.	New York 6	3390—165 Broadway Bldg.
Boston 10	1048—201 Devonshire St.	Philadelphia 3	1644—1700 Walnut Street Bldg.
Chicago 4	2196 McCormick Bldg.	Pittsburgh 19	3260 Alcoa Bldg.
Cleveland 15	2262 Midland Bldg.	Salt Lake City 4	550 West 17th South St.
Detroit 26	1551 Lafayette Bldg.	San Francisco 4	1585—200 Bush St.
Havana	402 Abreu Bldg.	Seattle 1	1350 Henry Bldg.
Houston 2	2115 C & I Life Bldg.	Tulsa 3	1646 Hunt Bldg.

WE PLEAD GUILTY

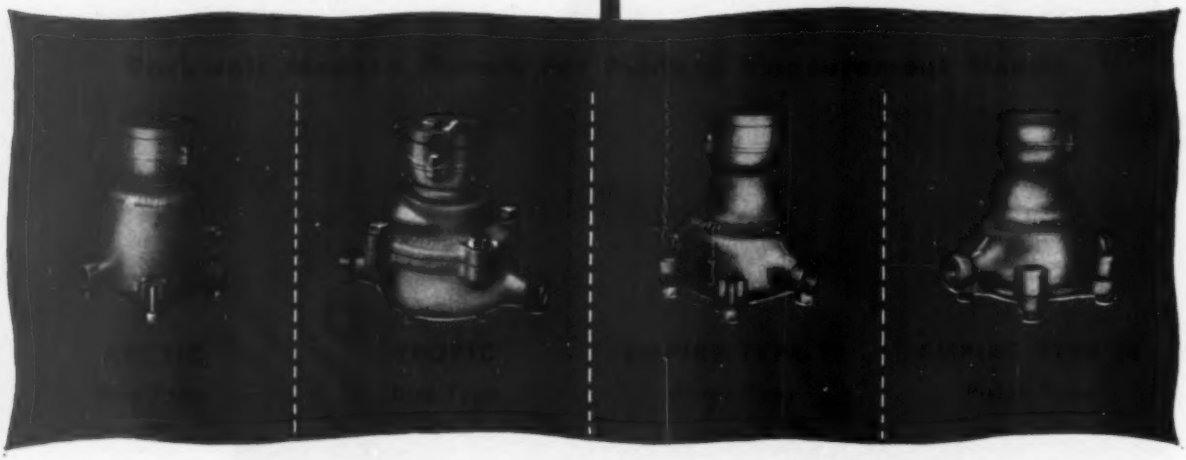
To Improving Water Meter Performance

Chances are the meters you bought 20 or more years ago are costing you money way out of proportion to their revenue earning capacity. These old meters, even when new, could not approach the performance we're building into meters today.

We've worked constantly for improvement and our meters show it. Engineering, research and manufacturing have combined their talents to make Rockwell meters measure at top accuracy for longer periods at lower cost.

So think twice before again repairing a meter that creaks with age. Think first of the costs in parts and labor and weigh them against the cost of a new Rockwell. Then think of the greater revenue a new Rockwell will earn for you.

Let the Rockwell representative furnish proof that a planned program of meter replacement will so materially benefit your overall operations that it will more than pay for itself.

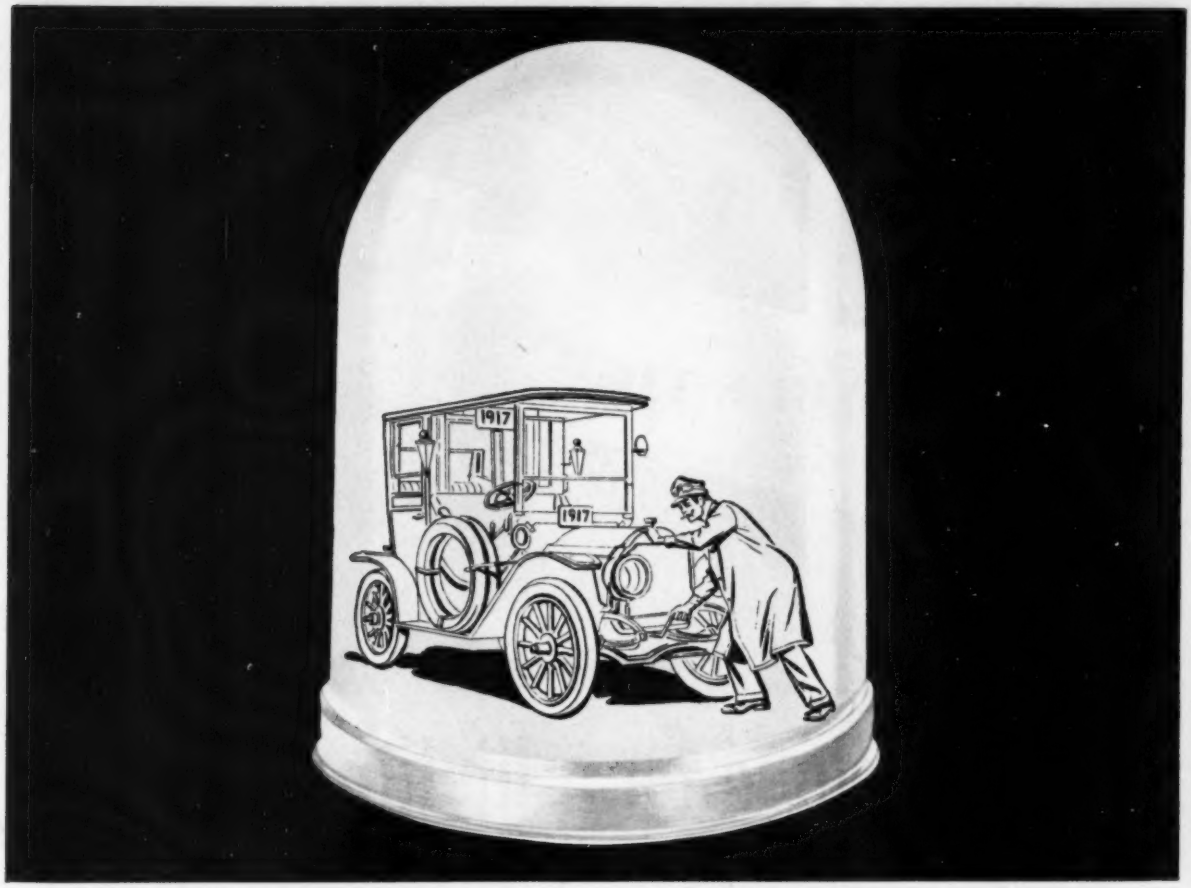


The Symbol for Service, Quality and Performance in Water Meters

ROCKWELL MANUFACTURING COMPANY

PITTSBURGH 8, PA. Atlanta Boston Chicago Houston
Los Angeles N. Kansas City New York Philadelphia
Pittsburgh San Francisco Seattle Tulsa

In Canada: Peacock Brothers Limited



how much does it cost... to "crank" an old style chlorinator?

The automobile self-type starter isn't news any more—nobody ever cranks a car these days. "Cranking" an old-style chlorinator is equally out-dated.

The F&P mechanical, instrument-type chlorinator is sweeping the country, sales mount month by month. Why? Because municipality after municipality, consulting engineer after consulting engineer, reports the same facts: F&P chlorinators are lower in first cost, are easier to handle, because they are so simple in design, so light in weight, so modern in construction. More important, however, it is always stressed that F&P chlorinators require practically no maintenance, practically no spare parts.

We claim that if you are operating a chlorinator that has a bell jar on it *you need a new chlorinator.* You are "cranking" an old, costly, inefficient chlorinator. Everybody knows that dry chlorine is not corrosive—but that as soon as you put the chlorine in contact with water or water vapor it becomes corrosive. That's what the water tray types of chlorinators do—put dry, non-corrosive chlorine in contact with water and make corrosive vapor out of it. It's not engineering sense and the way to avoid it—and the resulting expensive maintenance—is to get F&P *mechanical, instrument type chlorinators.*

Don't refrain from writing us because you don't need additional chlorinating capacity right now. Moreover if it is time for a major overhaul or a rebuilding of your bell jar chlorinator, let us quote you for doing this work. We will give you what you may not have gotten previously—a firm price for doing the job before we start on it. The price will be a reasonable one, but we'll also quote you a price for replacing the chlorinator and if you want to spread the cost of the new one by time payments or if you want a lease arrangement, you can have it. Chances are you cannot justify further overhaul or further rebuilding—even at our *fair* price for the work.

FP

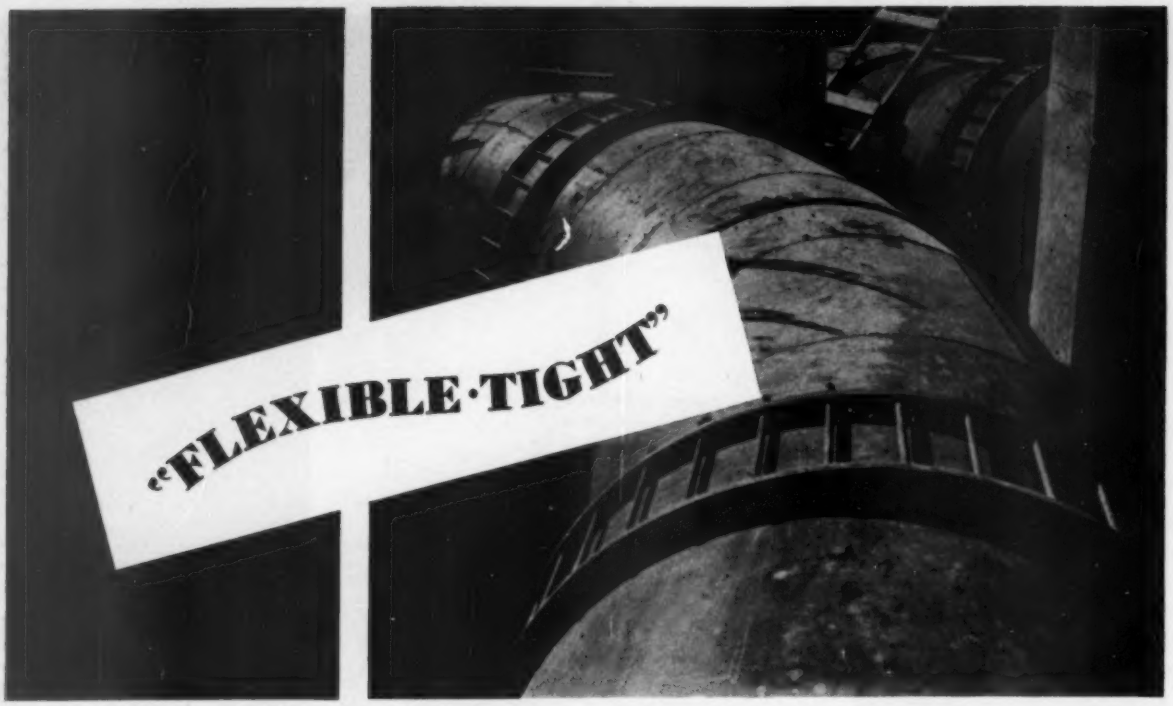
complete process instrumentation

FISCHER & PORTER CO.

194 Fischer Road, Hatboro, Penna.

18 YEARS EXPERIENCE SUCCESSFULLY MANUFACTURING CHLORINE FLOW METERING EQUIPMENT

LA 1010 A



Joined for a lifetime...

These twin 67" air mains are a part of Sanitary District Sewage Works, in Chicago. Joined with Dresser Couplings to provide complete year-round dependability, they supply tremendous volumes of compressed air for Chicago aeration tanks. Expensive leaks could not be tolerated.

A fraction of a pound saved in air pressure would result in dollars saved in electric power costs. Dressers were selected for the job to assure that saving.

Dressers provide complete dependability because they stay airtight despite pipe movements common to all lines through the seasons. Specially compounded rubber gaskets in Dresser Couplings take up expansion-contraction stresses, vibration, earth movements, and stress from settling foundations.

And Dressers are factory built and tested . . . ready to install when you get them.

Installation is simple. Average time is 2 man-minutes per bolt, using only a wrench. You save time and labor costs, and eliminate the need for expensive repairs and maintenance, because Dressers stay "Flexible-Tight". In numerous installations they have been in service 50 years and more.

Write today for more information about Dresser applications on water, sewage, and industrial waste projects.

Dresser-Coupled air distribution lines to aeration tanks at the West Side Sewage Treatment Plant, in Chicago. Here again, sanitary engineers selected Dressers to assure airtight pipe joints through the entire distribution system. Simple, economical construction that can be depended on for years of trouble-free service.

DRESSER

COUPLINGS

Dresser Manufacturing Division, 60 Fisher Ave., Bradford, Pa. (One of the Dresser Industries). Warehouses: 1121 Rothwell St., Houston, Texas; 101 S. Bayshore Highway, South San Francisco, California. Sales Offices: New York, Philadelphia, Chicago, Houston, South San Francisco. In Canada: Toronto, Ontario.

Dependable water storage—

AN ESSENTIAL PART OF ATLANTIC CITY'S WELCOME TO THE WORLD

PITTSBURGH
•DES MOINES

Elevated Steel Tanks

As host to millions, Atlantic City spares no effort to protect the health and safety of its guests. The resort's latest addition to better water service is this 1,000,000-gallon Pittsburgh-Des Moines Elevated Steel Tank. Of radial-cone design, the tank measures 71 feet in diameter, has a 35-foot head range, and tower height 80 feet to bottom. • Write for our "Modern Water Storage" brochure.

PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25) ..... 3418 Neville Island	DES MOINES (8) ..... 919 Tuttle Street
NEWARK (2) ..... 218 Industrial Office Bldg.	DALLAS (1) ..... 1223 Praetorian Bldg.
CHICAGO (3) .. 1222 First National Bank Bldg.	SEATTLE ..... 526 Lane Street
LOS ANGELES (48) ..... 6399 Wilshire Blvd.	SANTA CLARA, CAL. ..... 625 Alviso Road

With 100 years

Ewing Galloway

This is New York, as seen from East River, showing Empire State, Chrysler and United Nations buildings.

Bettmann Archive

Old print showing cast iron water mains being installed in New York about 100 years ago.

MODERNIZED cast iron

of EXPERIENCE...
they must be right

NEW YORK installed cast iron water mains 100 years ago... and installs them today!

One hundred years ago, New York was a city of about 750,000 population, served by 237 miles of water mains. Today's eight million population requires 5500 miles of mains, of which 98% are cast iron. Some of these mains are still functioning after a century and more of service. From 90 M.G.D. a century ago, capacity has grown to 1500 M.G.D.

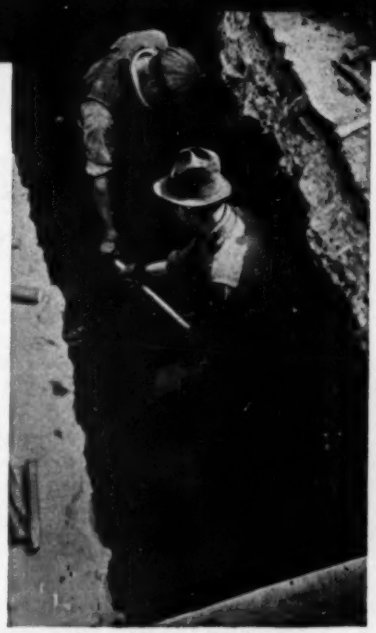
A customer who buys your product year after year—generation after generation—is a "jewel beyond price". Be you merchant or manufacturer, you might count such customers on the fingers of your two hands. Yet, the cast iron pressure pipe industry can count more than 60 of them—utilities that have been buying cast iron pipe for water or gas mains (or both) for 100 years.

Cast iron pipe has been a rugged, long-lived product from the earliest days. Today's *modernized* cast iron pipe, centrifugally cast, is even stronger, tougher, and more uniform in quality. And, where needed and specified, it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout the long life of the pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3.

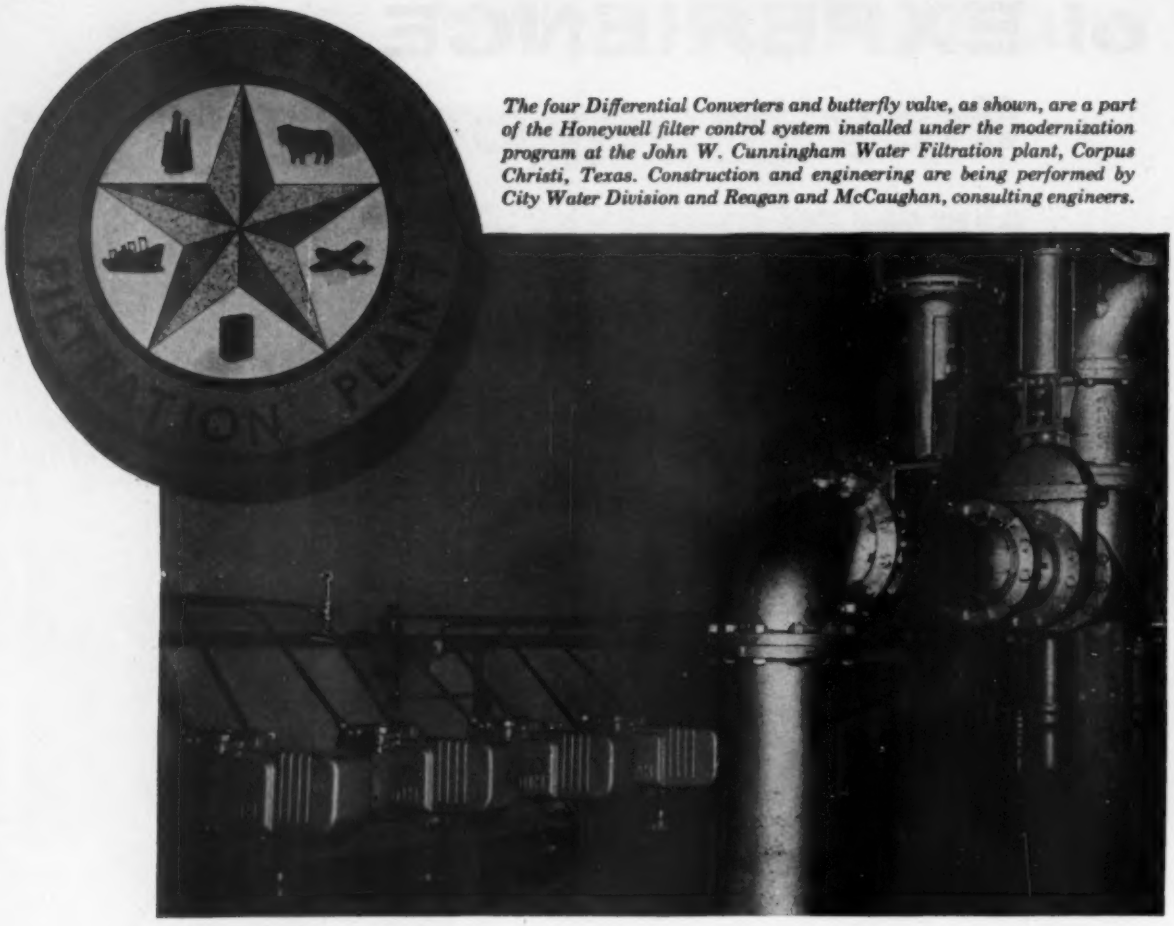
CAST Q IRON ®

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.



In good condition after 100 years of service, this cast iron distribution main is one of several still functioning in New York City.

pipe FOR MODERN WATER WORKS OPERATION



The four Differential Converters and butterfly valve, as shown, are a part of the Honeywell filter control system installed under the modernization program at the John W. Cunningham Water Filtration plant, Corpus Christi, Texas. Construction and engineering are being performed by City Water Division and Reagan and McCaughan, consulting engineers.

Engineered instrumentation simplifies operation of sand filters

How will you have your sand filter control . . . manual, semi-automatic or full automatic? With the integrated Honeywell control system, filter operators can choose at will the exact kind of control they need at any instant . . . without leaving the control room or filter operating floor.

This modern method of regulating sand filters utilizes Honeywell instrumentation that has been service-proved not only in water and sewage applications, but in thousands of critical industrial processes. This team of instruments combines flexibility, simple construction, easy operation and low cost.

Honeywell Differential Converters are the remote measuring elements which transmit data on flow rate and liquid head to miniature *Tel-O-Set* indicators and controllers on the central panel. Built-in switches let the operator designate how flow is to be controlled . . . automatically in accordance with clear well level, reservoir level or manual setting . . . or manually by means of settings at local or remote control stations. In addition, automatic recording instruments chart a precise, continuous history of each critical variable.

Your local Honeywell sales engineer will be glad to discuss your own applications for this system with you and your consulting engineer. Call him today . . . he's as near as your phone.

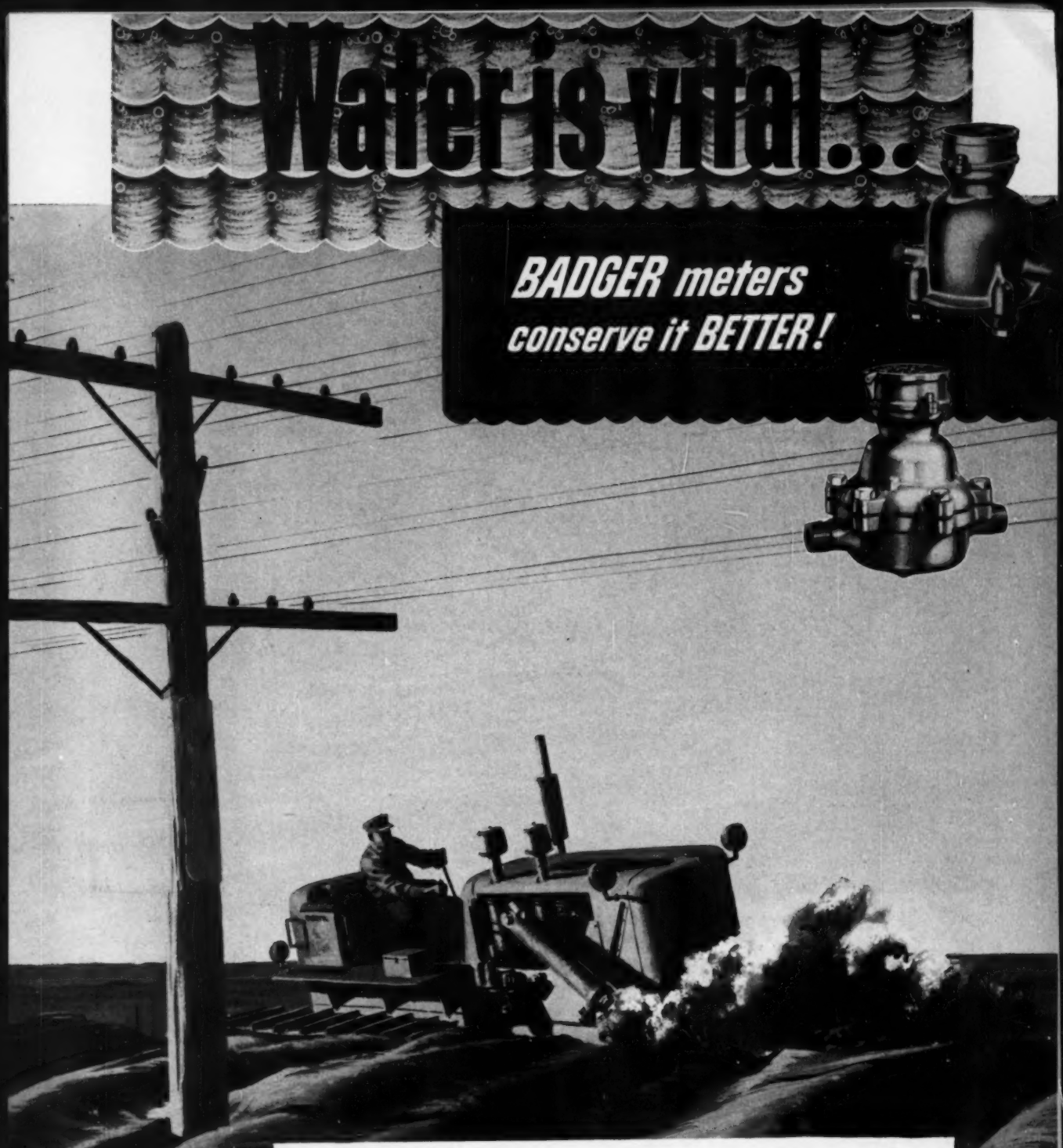
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Bulletin 2290, "Differential Converter Transmitters."**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

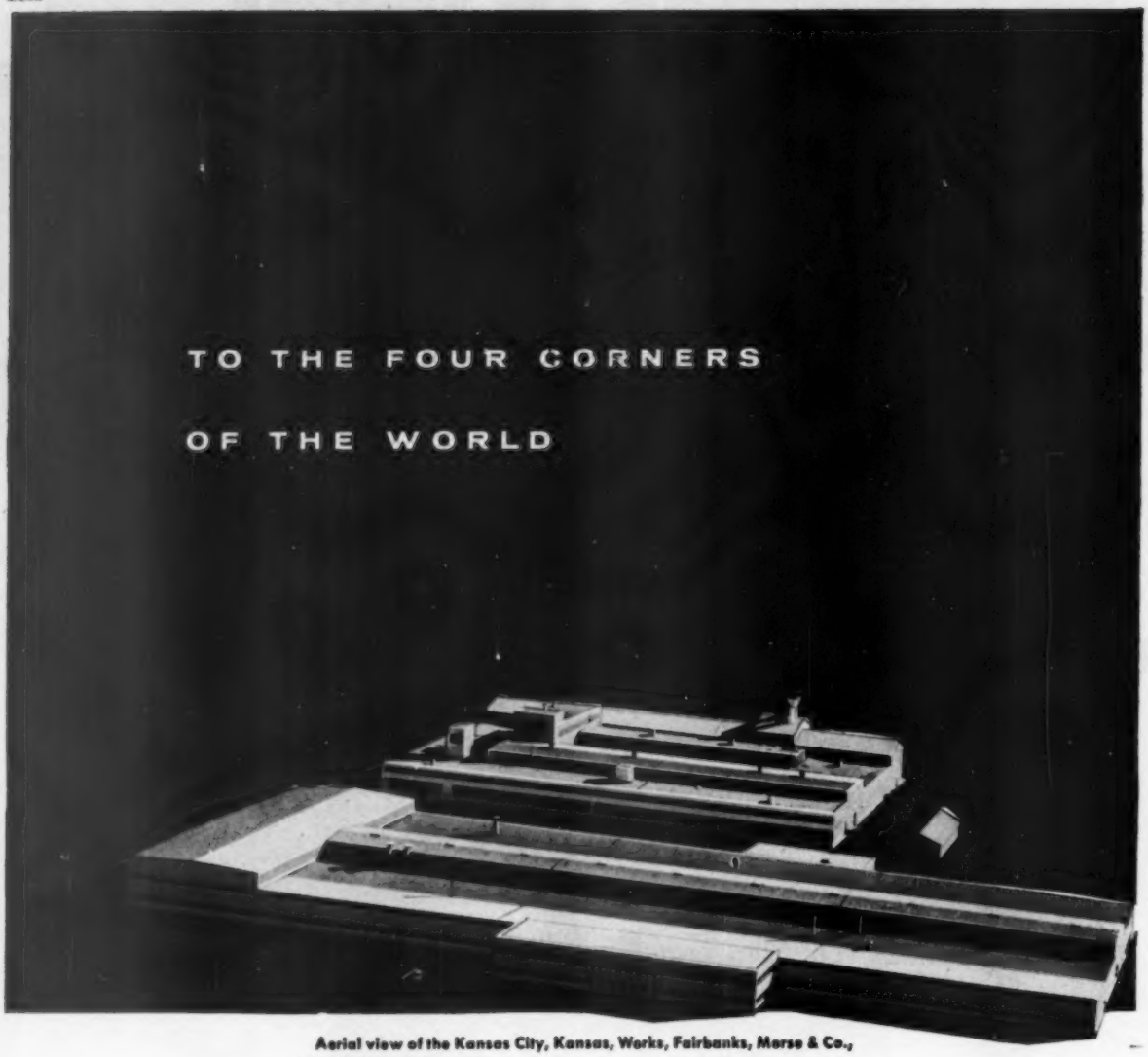


THE cropless wastes of once-fertile land have proved it again... water makes the difference between food and famine! Today, thousands of farmers and ranchers must haul water from nearby towns. With water supplies so low, Badger meters are almost as vital as the water itself. They provide a precise check on usage and waste... assure a fair allotment of the water available... and help water departments get a fair price for water and service. As a result, Badger meters even help keep waterworks self-supporting for thousands of communities. And they operate dependably, economically, with a minimum of servicing.

BADGER Water Meters

BADGER METER MFG. CO.
Milwaukee 10, Wisconsin

"Measures the water of the world"



Aerial view of the Kansas City, Kansas, Works, Fairbanks, Morse & Co., 3601 Kansas Avenue.

...from Kansas City

Yes, from our new, modern-as-tomorrow works at Kansas City, we serve the world's needs for pumps.

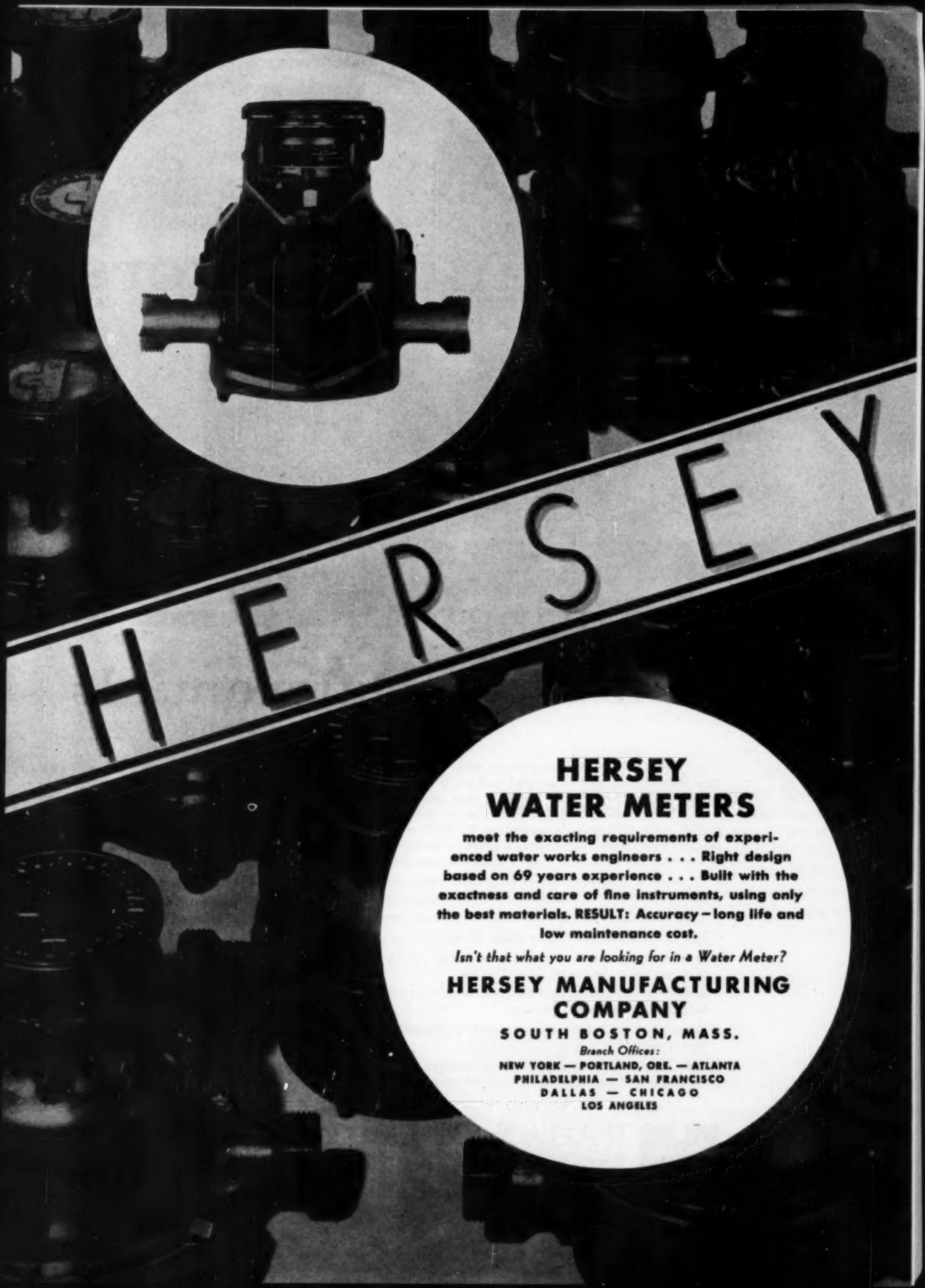
As a major supplier of quality pumping equipment, it is particularly suitable that this new Fairbanks-Morse plant be located at an important crossroads of the world ... Kansas City. In this new plant 190,000 square feet of manufacturing space and a complete foundry occupying 150,000 square feet are devoted to bringing better service to our customers all over the world.

Modern manufacturing, development and testing equipment backed by engineering and production skills of highly trained personnel combine to produce products of unmatched quality ... in performance, durability, economy. Fairbanks, Morse & Co., Chicago 5, Illinois.

FAIRBANKS-MORSE

a name worth remembering when you want the best

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • FARM MACHINERY • MAGNETOS



HERSEY WATER METERS

meet the exacting requirements of experienced water works engineers . . . Right design based on 69 years experience . . . Built with the exactness and care of fine instruments, using only the best materials. RESULT: Accuracy—long life and low maintenance cost.

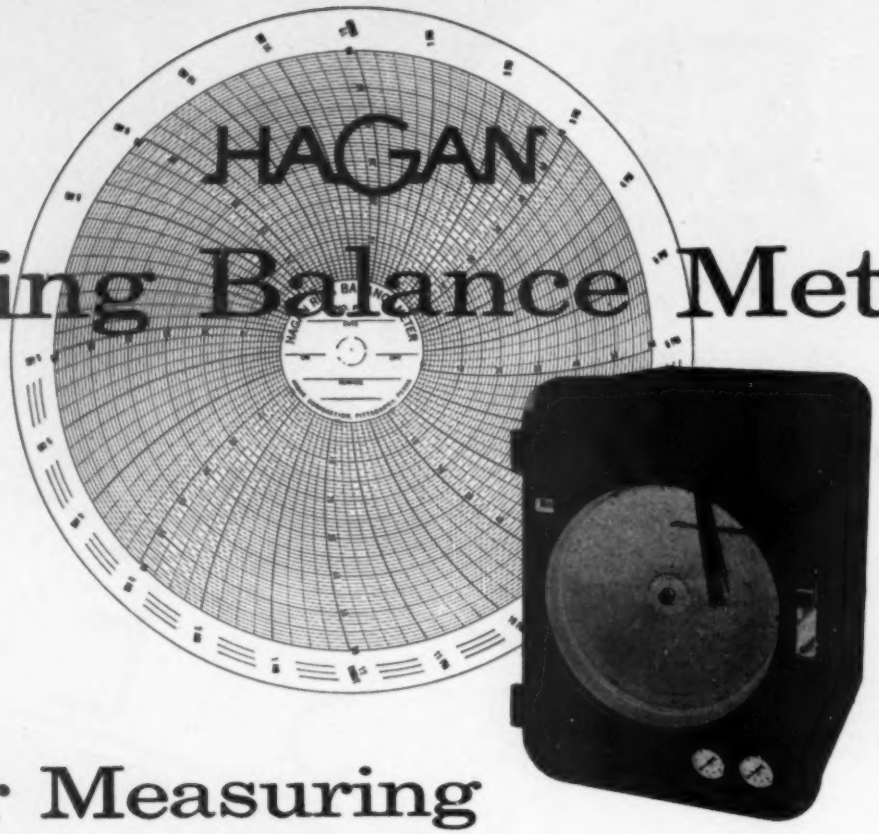
Isn't that what you are looking for in a Water Meter?

HERSEY MANUFACTURING COMPANY

SOUTH BOSTON, MASS.

Branch Offices:

NEW YORK — PORTLAND, ORE. — ATLANTA
PHILADELPHIA — SAN FRANCISCO
DALLAS — CHICAGO
LOS ANGELES



Ring Balance Meters

for Measuring

Low Full Scale Differentials

The necessity for measuring flows, with only a low full scale differential available, may result from any of several factors. Type and location of the source of differential, or lines oversize for the flow rate, are encountered most frequently.

The Hagan Ring Balance Meter is particularly adapted for accurate operation at full scale differentials as low as 1" WC, with any type of primary element—venturi tube, weir, flume, orifice plate or flow nozzle.

For such services, the Hagan Ring Balance Meter has these advantages:

- There is a complete series of interchangeable sensing elements for full scale differentials from 1" to 420" WC at static pressures up to 3000 psig.
- Ring assemblies are always selected to have ample power at all flow rates.
- The differential measuring range of any ring is adjustable over 7 to 1 range.
- Dead weight check of calibration takes only a few minutes. It is not necessary to disconnect the meter from the line.
- Automatic compensation for such factors as fluid density, pressure and temperature is a standard attachment.
- Pneumatic or electric transmission is available for remote recording or for automatic control.

Hagan engineers are prepared to suggest the instruments best suited for new construction or modernization and extension of existing facilities.

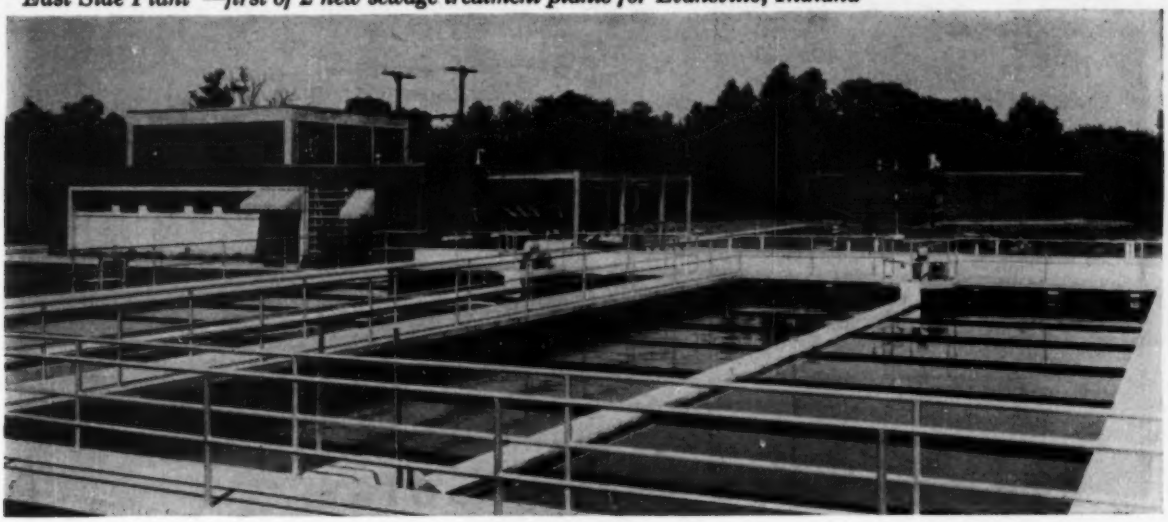
HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

HAGAN BUILDING PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems, Ring Balance Flow and Pressure Instruments, Metallurgical Furnace Control Systems, Control Systems for Automotive and Aeronautical Testing Facilities

"East Side Plant"—first of 2 new sewage treatment plants for Evansville, Indiana



Evansville joins Ohio River clean-up program

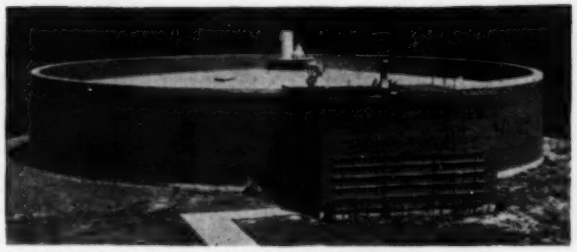
TWO-PLANT, 28 MGD PROJECT INCLUDES PFT "CONTROLLED DIGESTION"

At Evansville, Indiana, the first of two proposed primary treatment plants is completed . . . another stride forward in the 8-state Ohio River Valley clean-up program! Called the "East Side Plant" the new 6 MGD plant adopted PFT equipment for modern "controlled digestion".

The new 75′ digester is equipped with a *PFT Floating Cover* for simplified operation, positive scum submergence and safe utilization of gas. The digester is also provided with a *PFT Supernatant Liquor Selector* for automatic, continuous withdrawal of the best digester liquor. A *PFT Gauge, Sight Glass and Sampler* unit enables operator to keep close control of supernatant.

An important feature of Evansville's "controlled digestion" is the *PFT Digester Heater & Heat Exchanger*, an external heater with a capacity of 750,000 B.t.u. per hour. Fired by either gas *or* oil, it utilizes all sludge gas produced, switching to oil only when necessary.

In the control building attached to the digester, a *PFT Cover Position Indicator* records the digester liquid level at a glance. *PFT Gas Safety Equipment* in the building includes flame cells, flame traps, pressure relief with flame trap, gas pressure gauge and a waste gas burner.



New 75′ Digester with PFT Floating Cover

Contracts have recently been let for the "West Side Plant", a 22 MGD plant designed to serve a population equivalent of 212,000. Specifications for "West Side" call for the following PFT equipment: four 75′ Floating Covers; three 8″ Rotary Sludge Withdrawal Valves; two Heater & Heat Exchanger units; four Cover Position Indicators; four Supernatant Liquor Selectors; four Supernatant Gauge, Sight Glass & Sampler units; various items of Gas Safety Equipment.

Design of plant by / *Consoer, Townsend & Associates, Chicago, Illinois*

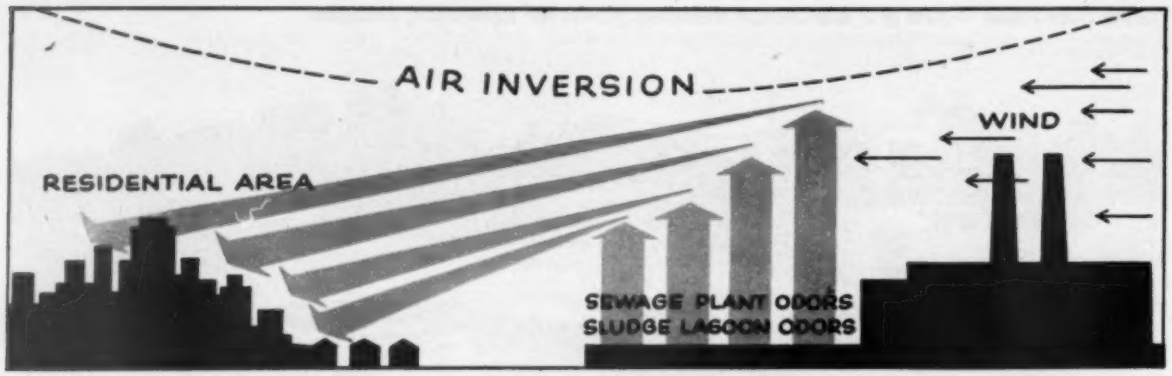
P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.

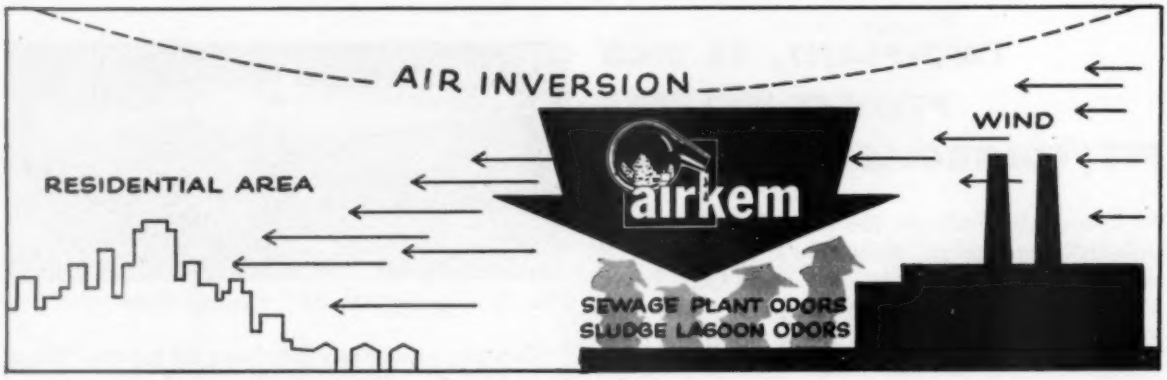
4241 Ravenswood Avenue
Chicago 13, Illinois

NEW YORK • LOS ANGELES • SAN FRANCISCO • CHARLOTTE, N. C • JACKSONVILLE • DENVER



A multi-million-dollar sewage treatment plant was in trouble. Despite "care, cleanliness and chlorine," unpleasant odors were invading the homes of 30-thousand nearby residents.

AIRKEM took this problem and solved it!



Stumped for an economically-sound solution, officials called in Airkem's Industrial Odor Service. After carefully analyzing the problem, the odor trouble-shooters installed simple, low-cost equipment for dispensing a new Airkem product formulated specifically to counteract airborne sewage odors.

Results were immediate and gratifying. The odors were gone. And not only were good relations re-established with the neighbors, but the plant staff was pleased as punch with their improved working conditions. Best of all, the results had been accomplished at moderate cost and without affecting plant operation.

If odors are damaging your plant's public relations, it will pay you to call in Airkem's Industrial Odor Service specialists. They have the low-cost answers to sewage odor problems of widely differing types and degrees of complexity. And behind them are the facilities of the world's largest laboratory devoted exclusively to the study and solution of odor problems.

Consultations are strictly confidential, incur no obligation. Call your local Airkem representative now (he's listed in your phone book), or write today to Airkem, Inc., 241 East 44th Street, New York 17, N. Y.

FOR INDUSTRIAL • MUNICIPAL
INSTITUTIONAL • COMMERCIAL USE

airkem ODOR COUNTERACTANTS

MUELLER®

AWWA IMPROVED FIRE HYDRANTS

OIL FILLER PLUG
Check oil level quickly with dipstick and add oil if needed without removing bonnet.

OIL RESERVOIR
Positive, automatic lubrication of all stem threads and bearing surfaces each time hydrant is operated.

"O" RING SEALS
Permanent, water-tight seal without adjustments or binding.

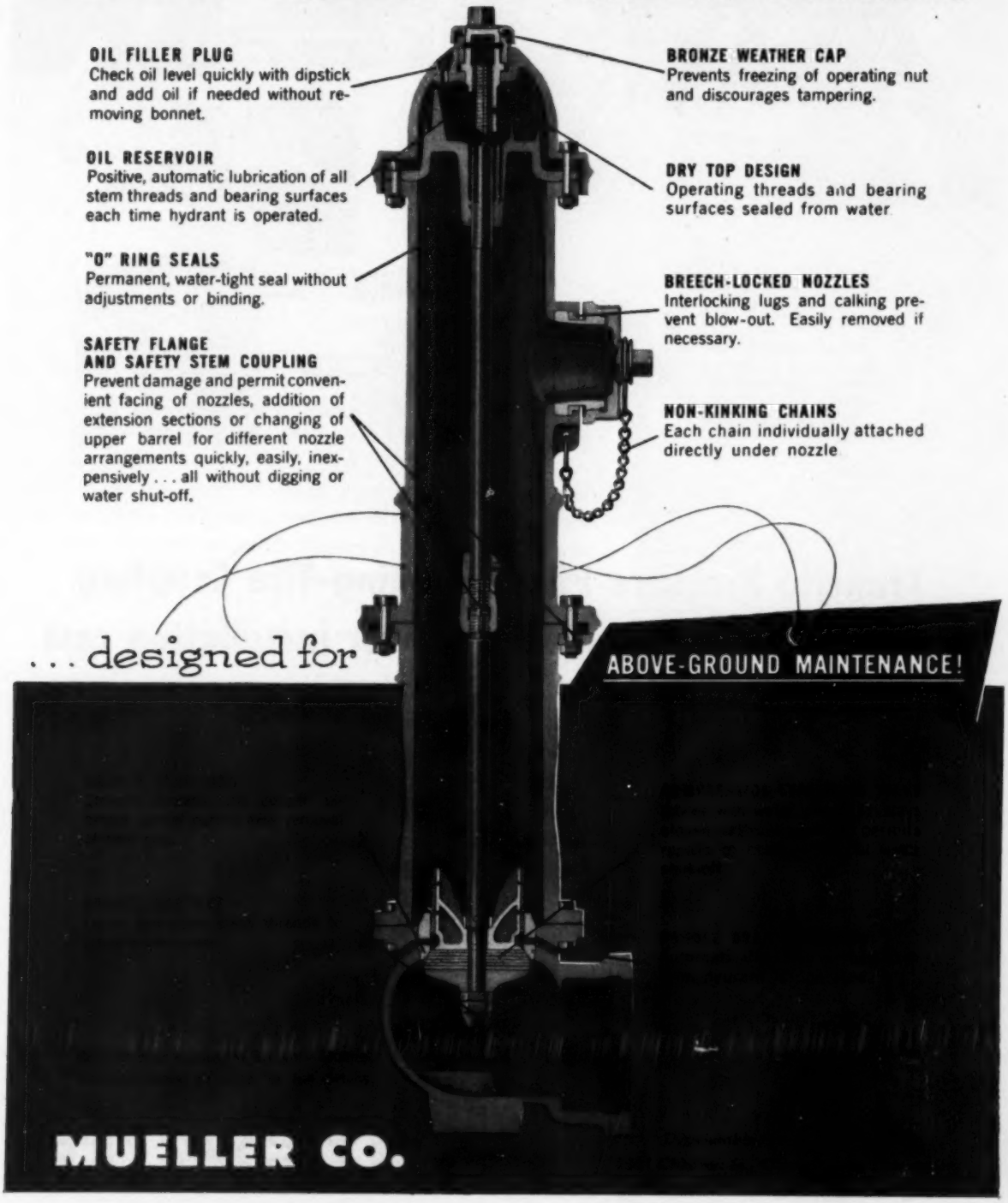
SAFETY FLANGE AND SAFETY STEM COUPLING
Prevent damage and permit convenient facing of nozzles, addition of extension sections or changing of upper barrel for different nozzle arrangements quickly, easily, inexpensively . . . all without digging or water shut-off.

BRONZE WEATHER CAP
Prevents freezing of operating nut and discourages tampering.

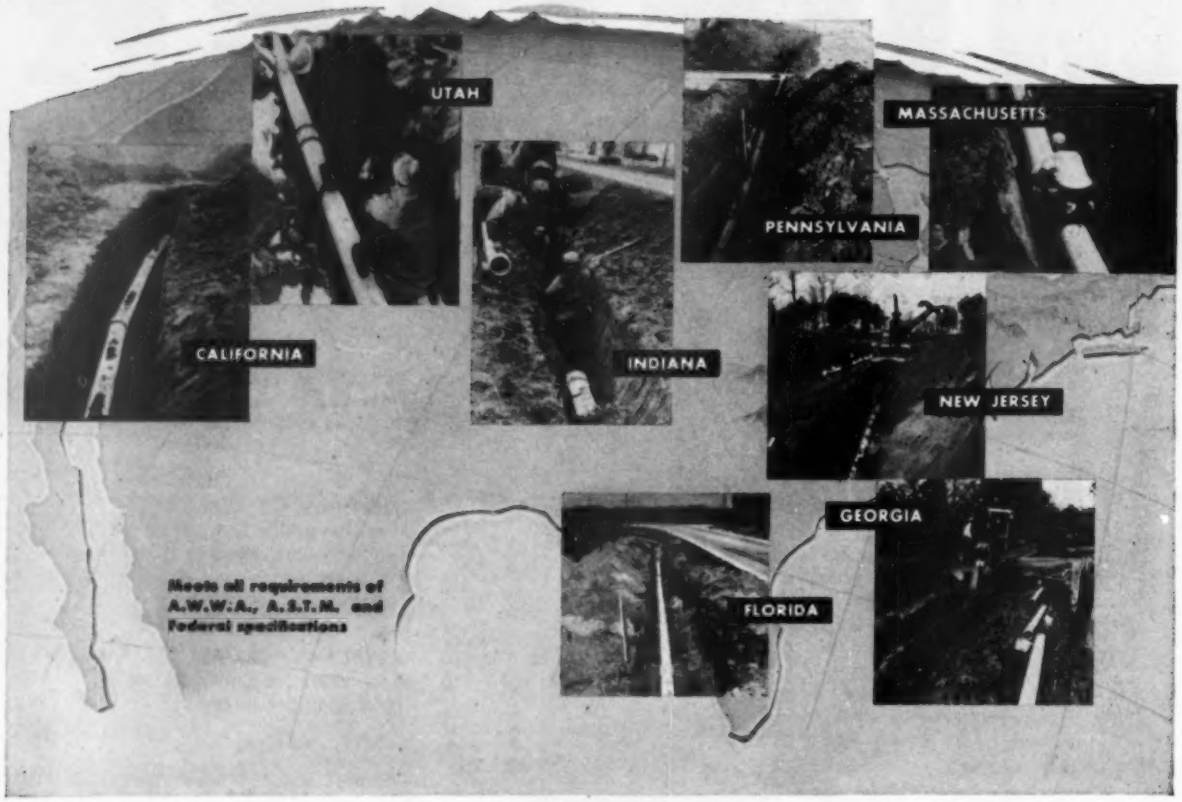
DRY TOP DESIGN
Operating threads and bearing surfaces sealed from water

BREECH-LOCKED NOZZLES
Interlocking lugs and calking prevent blow-out. Easily removed if necessary.

NON-KINKING CHAINS
Each chain individually attached directly under nozzle



Setting new standards—everywhere...



Transite Pressure Pipe and Ring-Tite Coupling speed water line assembly, lower installation cost

IN COMMUNITY after community, proof that Transite® Pressure Pipe and Ring-Tite® Coupling speed water line assembly and cut installation costs is reflected in such contractor comments as these:

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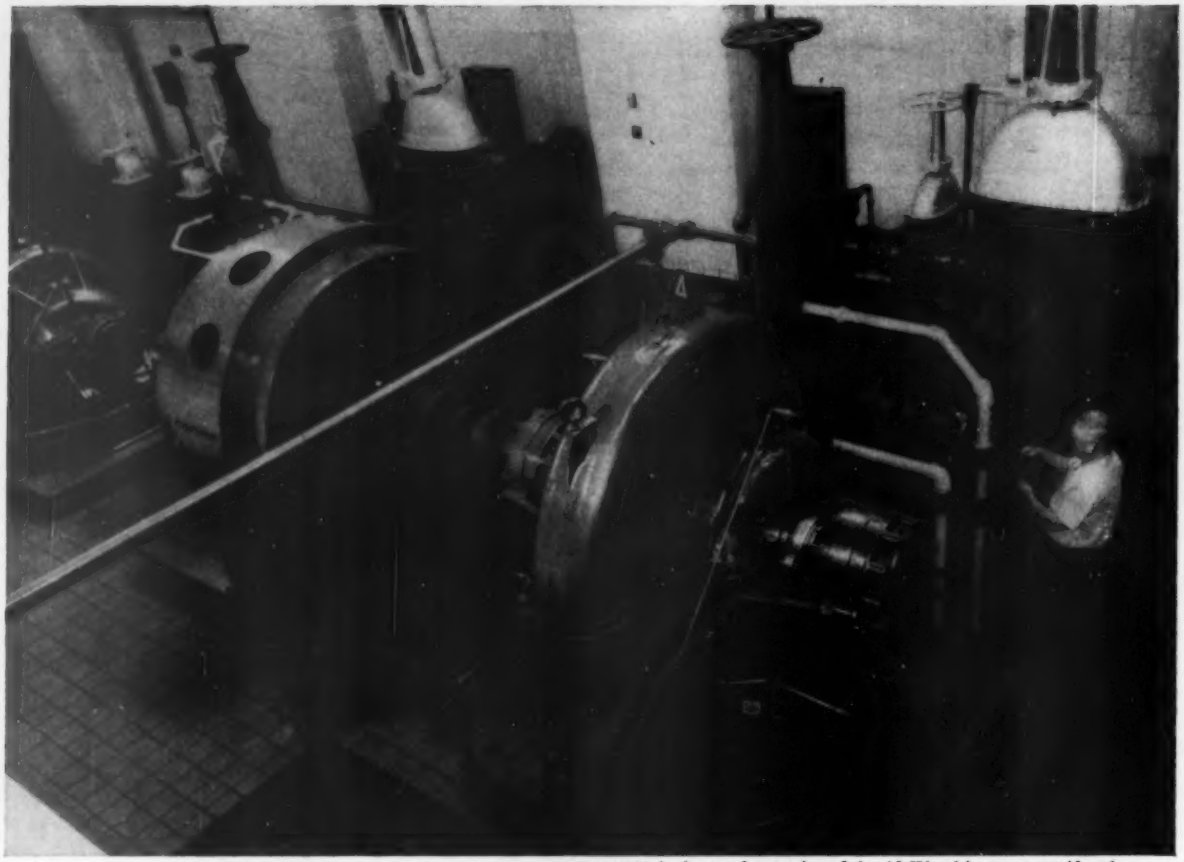

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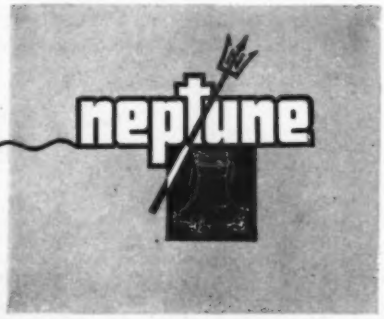

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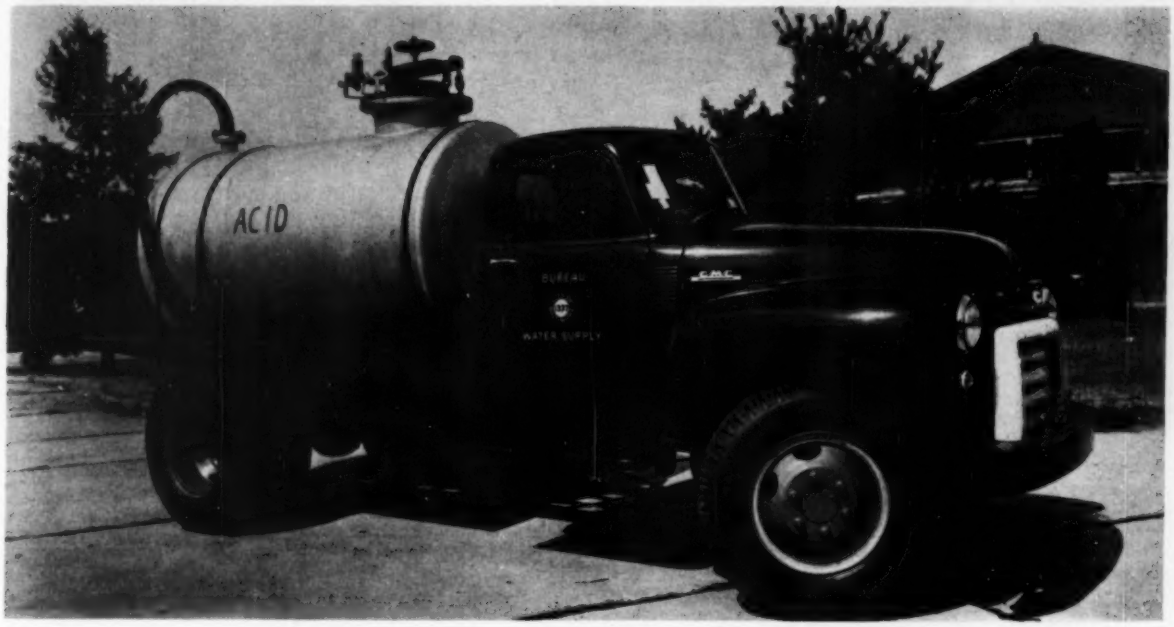


TANK TRUCK delivers the acid. Rubber-lined tank holds 1064 gallons.

How Baltimore Fluoridates

Why fluosilicic acid was selected and how treatment is operated

by EDWARD S. HOPKINS

Mr. Hopkins was Principal Associate Engineer of the Bureau of Water Supply, Dept. of Public Works, Baltimore, Md., at the time this paper was prepared.

On October 1, 1954, he retired from Municipal service and opened his own office as Consulting Engineer.

NOVEMBER 26, 1952, is the date on which the fluoridation of the Baltimore water supply was instituted, using fluosilicic acid as the source of the fluoride ion. The acid is applied to filtered water in a conduit leading to the clear well, in each of the two plants comprising the Montebello Filters.

Fluorine Compounds Compared

Sodium fluoride, sodium fluosilicate, fluosilicic acid and hydrofluoric acid were considered for fluoridation treatment. If the granular compounds were used, they would be purchased in 375-pound fiber drums, while the liquids are available in rubber or plastic-lined steel drums or tank trucks.

Based upon a water usage of 200 mgd., the following quantities would be required:

NaF	3683 pounds/day or 672 tons/year
Na_2SiF_6	2176 pounds/day or 397 tons/year
H_2SiF_6	1667 pounds/day or 304 tons/year
HF	1754 pounds/day or 320 tons/year

which translated into commercial materials indicates that yearly requirements would be 706 tons of NaF at 95%, 403 tons of $NaSiF_6$ at 98.5,

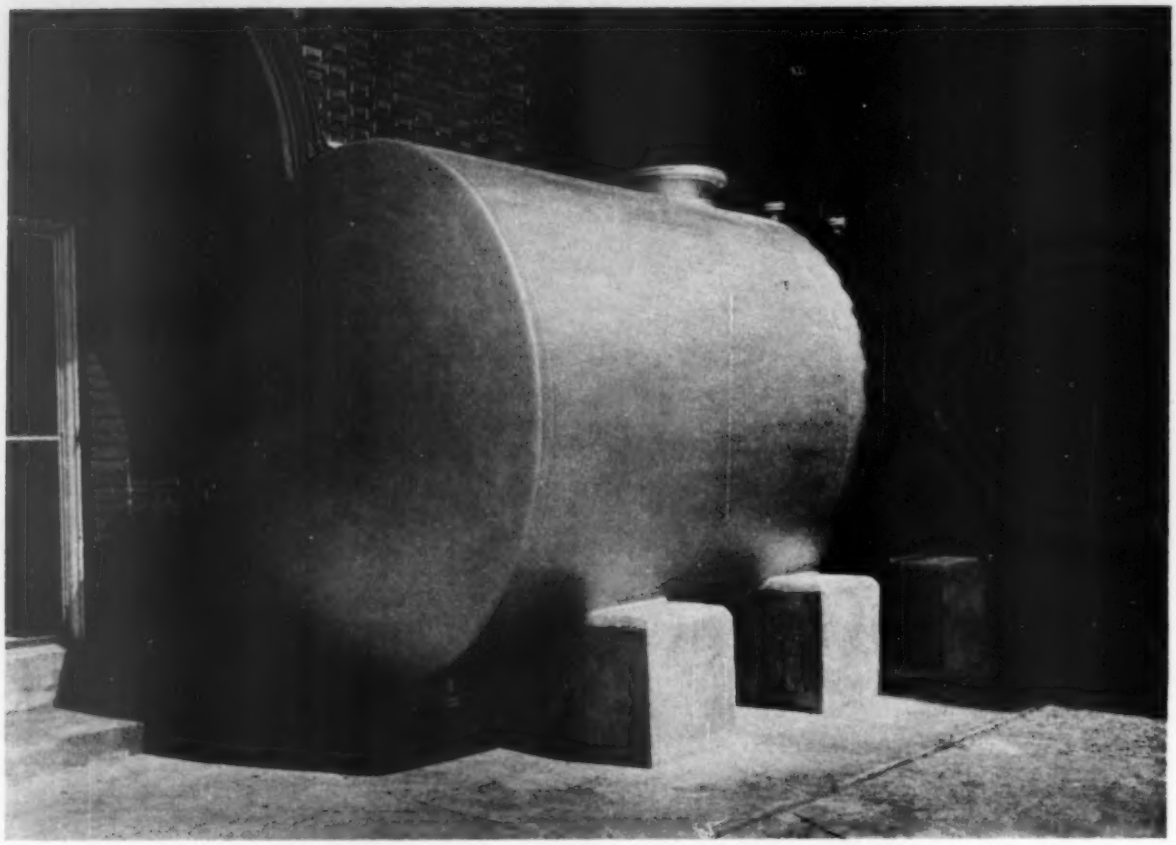


Fig. 1—STORAGE, rubber-lined, holds 5640 gallons. One of two installed.

1216 tons of H_2SiF_6 at 75.0 and 458 tons of HF at 70.0.

Sodium fluoride is 4 per cent soluble in cold water while sodium silicofluoride is only 0.044 per cent soluble. Therefore, a large volume of water is required to dissolve these compounds, namely, three gallons to dissolve one pound of sodium fluoride and 30 gallons for one pound of sodium silicofluoride. Solubility tables indicate that sodium silicofluoride is 2.45 per cent soluble in boiling water (212°F) and 2 per cent soluble in water at 185°F. Sodium fluoride is 5 per cent soluble in boiling water. It is apparent that satisfactory operation would require hot water at 185°F to dissolve these compounds at a rate of not less than six gallons per pound of material.

Proposed Chemical Feeding

Utilization of the dry granular compounds would necessitate provision for storage of these materials and accurate mechanical equipment for feeding them into the water. Two dust-tight feeders and dissolving tanks would be placed on the control floor at ground level, and would have extension hoppers to the chemical storage floor above them.

Since these fluoride salts are very toxic, it would be necessary to construct a separate room for them in each plant on the storage floor. To avoid emission of toxic dust into the air, with resultant damage to foliage, etc., each room would be equipped with a large exhaust fan connected to ducts discharging under water. Storage capacity for fifteen days' supply, or approximately 40 tons of material, would be required. This is an appreciable amount of space, since it must accommodate 225 drums.

When handling granular fluoride salts, personnel would be trained to use standard dust masks and wear protective chemical clothing. This is necessary since handling approximately one ton per day of this toxic material is a much greater hazard than that existing in the smaller plants where only one or two bags of 100 pounds each, or possibly a drum, is emptied into the feeder.

An additional filter operator would be required on the control floor for each eight-hour day, with increase of two other men in the mixing room from a six-day to a seven-day week. This is in contrast to the existing six-day work week, and would result in an increase of 25½ man-days per week or 1326 days per year.

Acids Have Advantages

Utilization of acids would require the erection of two rubber-lined steel storage tanks each of approximately 5,000 gallons capacity. Two proportionating pumps would take suction from these tanks and discharge directly into the filtered water conduits. Plastic pipe and fittings would be used to convey the liquid from storage to points of application.

Since there is no dust hazard, the installation of exhaust fans and the building of separate storage rooms would not be required with use of acids. The additional 1326 man-days per year would also be eliminated, since the regular filter operator can control acid application without increasing his work load. With truck delivery to the storage tanks, acids can be handled without undue hazard and the truck driver is the only man required to wear protective chemical clothing.

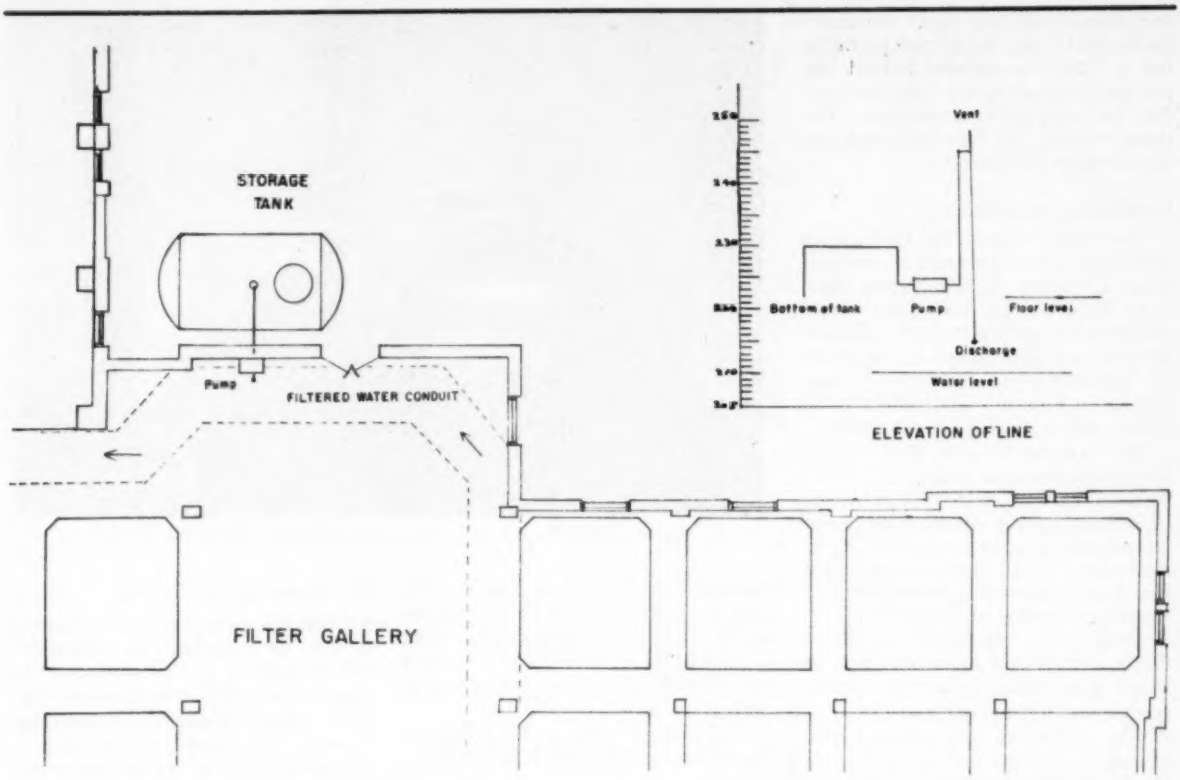


Fig. 2—SCHEMATIC flow diagram. Acid is pumped through Saran pipe to filtered water conduit.

Fluosilicic acid is not as corrosive as sulfuric acid and is easily removed from the skin by rinsing with clear cold water. If spilled upon clothing other than the chemical-treated type, prompt removal of clothing and rinsing in water or ammonia would be necessary.

Costs of Compounds Evaluated

Cost data developed in 1951 were as follows:

Table 1
Water in clear well—Fluorides ppm
Daily composite samples—1953

Month	Average	Maximum	Minimum
January	0.7	1.1	0.1
February	1.0	1.3	0.7
March	0.8	1.0	0.5
April	0.9	1.1	0.5
May	0.9	1.4	0.6
June	1.0	1.4	0.8
July	1.0	1.1	0.8
August	1.0	1.2	0.8
September	1.0	1.1	0.8
October	1.0	1.1	0.6
November	1.0	1.3	0.8
December	1.0	1.2	0.8

Sodium fluoride

Cost of sodium fluoride per year	$189,262.82
Interest at 2½% on equipment investment of $12,436.00 and amortization at 10%	1,554.50
Cost of additional plant operating personnel	12,323.84
	$203,141.16

Sodium silicofluoride

Cost of sodium silicofluoride per year	$ 78,212.15
Interest at 2½% on equipment investment of $12,436.00 and amortization at 10%	1,554.50
Cost of additional plant operating personnel	12,323.84
Cost of hot water to 200° F.	13,044.00
	$105,134.49

Fluosilicic Acid

Cost of fluosilicic acid per year	$ 60,800.00
Interest at 2½% on equipment investment of $14,072.20 and amortization at 10%	1,759.03
	$ 62,559.03

Hydrofluoric acid

Cost of hydrofluoric acid per year	$183,200.00
Interest at 2½% on equipment investment of $14,072.00 and amortization at 10%	1,759.03
	$184,959.03

It will be noted from the above data that fluosilicic acid was the cheapest source of fluorine. The ease of con-

Table 2
Water in Dist. System—Fluorides ppm
Various Locations—1953

Month	Zone: 1	2	3	4	5
Jan.	0.6	0.6	0.7	0.6	0.6
Feb.	1.0	0.9	0.8	0.9	0.8
March	1.0	0.7	0.8	0.8	0.8
April	1.0	0.7	0.7	0.7	0.7
May	0.9	1.0	0.9	1.0	0.9
June	1.0	1.0	1.0	1.0	1.0
July	1.0	1.0	1.0	1.0	1.0
Aug.	1.0	1.0	0.9	0.9	0.9
Sept.	1.0	0.9	0.9	0.9	0.9
Oct.	1.0	1.0	1.0	1.0	0.9
Nov.	1.0	1.0	1.0	0.9	0.9
Dec.	1.0	1.0	0.9	0.9	0.9

Average for System 0.9.
Monthly averages from 47 weekly samples.

trol when using this liquid would actually justify paying a small premium for it. There is no dust hazard and the operator on regular duty can handle the application procedure. For these reasons, the fluosilicic acid was the chemical of choice.

Installation at Baltimore

Two rubber-lined steel tanks, each eight feet in diameter and fifteen feet long, and each of 5640 gallon capacity, were specified. These were mounted on concrete saddles outside the plants and adjacent to the point of application in the filtered water conduits. Figure 1 illustrates the location and mounting of one tank.

The one-eighth inch thick rubber lining was cured to withstand the effects of fluosilicic acid. It has a weight of one pound per square foot and is guaranteed to give protection for at least five years. Tank linings were electrostatically tested before delivery, assuring absence of pin holes. Consideration was also given to plastic lining, but, based upon cost and an equal guaranteed protective period, rubber was more economical.

The additional equipment purchased by the city includes a five-ton truck chassis, carrying a four and one-half foot diameter by eight and one-half foot long rubber-lined steel tank holding 1064 gallons. This is used for conveying the acid from the factory to the Montebello Filters. The truck is illustrated in the head photograph.

Acid is discharged by gravity into the tank truck from overhead storage at the acid works. The truck is emptied by air at ten pounds pressure into the plant's storage tanks. This method has proven successful although it is believed that a positive acting centrifugal pump would be more advantageous. There is some element of risk to personnel from an acid burn when connecting the air hose to the tank dome. Such risk would not exist if the acid could be discharged by plugging in an electrical connector to operate a pump mounted on the truck chassis.

As shown in the diagram, Figure 2, the fluosilicic acid is pumped directly from the storage tanks through one-half inch diameter Saran pipe and fittings encased in standard galvanized pipe. A Milton Roy proportioning pump having a plastic head, glass valves and Hasteloy plunger, delivers the acid to the filtered water conduits.

The proportioning pump has a maximum capacity of 30 gallons per hour. It can be accurately adjusted in accordance with the flow of water through the plant to maintain a one part per million dosage of fluoride ion at all times. This is normally about 21 gallons of acid per hour. Figure 3 is a photograph of the proportioning pump.

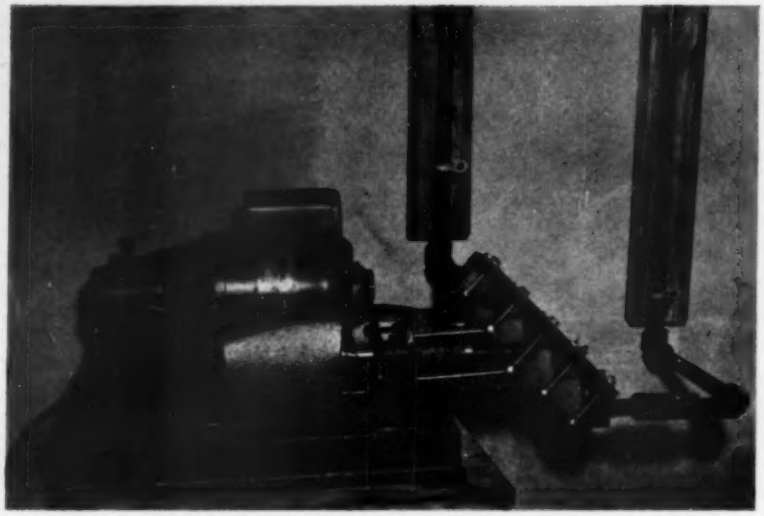


Fig. 3—CHEMICAL feed pump is constructed of resistant materials.

The itemized cost of the Baltimore installation in 1952 was as follows:

Truck chassis and hose	$ 3,071.75
3 rubber-lined tanks	6,100.50
2 pumps	905.00
Saran piping	487.00
Recording gage	471.00
Erection	2,010.65
	$13,045.90

A comparison of present prices for the chemicals indicates that the ratio of cost for these materials developed in 1951 still applies.

Control of Acid Dosage

While it is recognized that the Milton Roy proportioning pump is an accurate device, the discharge is checked daily by observation of the quantity of acid taken from the storage tanks. The height of liquid in each tank is measured by a Foxboro recording gage (No. 11298). This gage is inserted in an open vessel liquid level measurement system and is actuated by a continuous air purge. The chart is graduated in 0.2 foot increments and has been found to be sufficiently accurate. Calculations indicate the pumps to deliver a dosage that is 92.8 per cent of theoretical.

The fluosilicic acid is purchased on the basis of 25 per cent H_2SiF_6 and adjustment of dosage is calculated to this concentration. The purchase price of the acid is also adjusted to this concentration.

Distribution System Testing

Chemical control of water fluoridation is accomplished by collecting a 200 ml sample every two hours and compositing these samples daily. This daily composite sample is tested for fluoride ion concentration and, as shown in Table 1, has been consistent over the year.

In addition to the testing of the composite samples, some 47 stations throughout the distribution system are tested once weekly. The fluoride content of the water in the distribution system is shown in Table 2. It averaged 0.90 ppm. for the year.

Cost of Fluoridation Treatment

During 1953, 1492.6 tons of fluosilicic acid were purchased at a cost of $76,210.40. Haulage from the acid works to the filter plant amounted to 82 cents per ton for labor and truck operation.

An additional assistant was required in the laboratory to control dosage, and to do necessary testing, at a salary of $3,795.20. Interest at 2½ per cent and depreciation on equipment at 5 per cent was $974.44, or a total cost for the year of $93,285.82.

Appreciation

The information serving as the basis for this paper was obtained from the official records of the Baltimore Bureau of Water Supply, Department of Public Works, through the courtesy of Mr. Paul L. Holland, Director, and Mr. Joseph S. Strohmeyer, Water Engineer.

W&SW

Siphons in Pumping Plants

A review of the many practical applications of siphons and a discussion of their hydraulic problems

by HERBERT J. MEEKER, *Retired Asst. Vice Pres., Worthington Corp., Harrison, N.J.*

A SIPHON generally is considered to be a bent tube, having one side longer than the other, used to transport a liquid from a high to a low level over an elevation above the level of the liquid in the higher reservoir. After the siphon is filled and the flow starts, the flow will continue until the level in both reservoirs is the same. Care must be taken to prevent, at the high point in the siphon, an accumulation of air that will break the syphonic action and stop the flow of liquid.

History apparently fails to record exactly when, and by whom, it was discovered that siphonic action could be used to move liquids. In one of their tombs dating back to about 1500 B.C., the ancient Egyptians left evidence that they understood the principle of the siphon. It may have been used before that period. As time passed, many practical uses for the siphon were found, and in recent years siphons of immense size have been built.

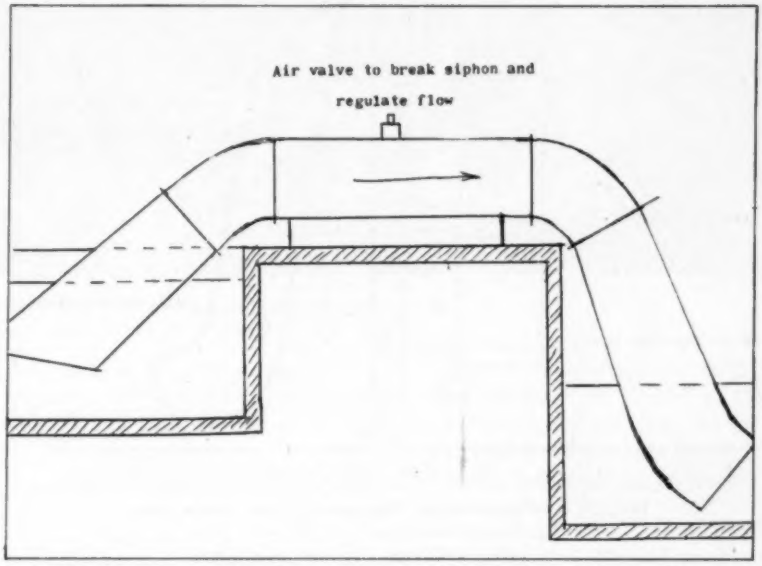
Pipe lines transporting liquids over long distances (especially aqueducts for water supply and drainage systems to sewage disposal plants) frequently utilize siphons to carry the liquid over a high point in the line. The inverted siphon, usually called an invert, is also used to transport liquid under a river or other obstruction which makes it impractical to continue the liquid line at the same grade.

Some notable examples of the use of an invert are:

(a) The Catskill Aqueduct of the New York City water supply, carried under the Hudson River from the West to the East Shore at Cornwall, N.Y.

(b) The flow of raw sewage to the Wards Island Sewage Treatment Plant, collected by interceptors on the Manhattan and Bronx Shores of the East and Harlem Rivers, and carried under the East River to the wet well of the pumping station at the Wards Island Treatment Plant.

(c) A similar invert in the discharge line from the New Jersey Avenue Pumping Station, Washington, D.C., carrying raw sewage to the Blue Plains Treatment Plant on the opposite shore of the Anacostia River.



SKETCH A—Siphon designed to transport liquid from drainage basin over levee to low level drainage canal. No pump is required.

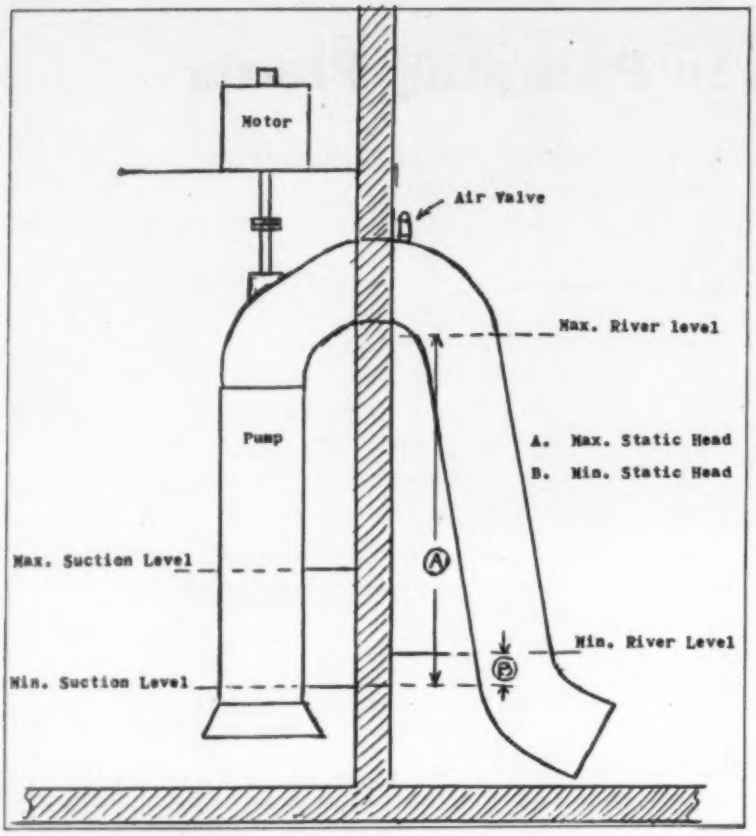
A very interesting installation of siphons is located near Marked Tree, Ark., where three large siphons each of 2600 cfs capacity are used to drain extensive acreage subject to flooding (see Sketch A). The water is carried over a levee and is delivered to a drainage canal at a lower elevation. Siphonic action is started by priming the siphons with a vacuum pump, and the volume of flow is regulated by admitting more or less air to the top of the siphon. These siphons were designed by the U. S. Engineer Office at Memphis, Tenn., and were put in operation in June, 1939.

Some idea of the immense size of these siphons can be had from the following data:

Each of the three tubes is 9 ft. in diameter at the crest, has an over-all length of 288 ft. Inlet and outlet ends of the tubes are bell-shaped, and have twice the cross section of the 9 ft. diameter sections. The siphons are designed for lifts of 15 to 28 ft.

Most pumping stations require some means to prevent back flow through the pumps when the pumps are stopped by intent or due to some interruption in the power supply. Various types of non-return valves are frequently used to prevent back flow. Many of these valves are equipped with devices to close them automatically when the pump is stopped.

For pumps of moderate size, non-return valves do not present a difficult problem except that the valve must be designed to prevent water hammer when the flow is stopped. The non-return valves for large capacity units sometimes require about the same space as the pumps, and their cost is a very considerable item in the total cost of the pumping station. A siphon in the discharge line from the pump frequently is used to prevent back flow when pumps are shut down; in this application, the siphon often solves the problem at a lower first cost and a lower maintenance cost than is required by non-return valves.



SKETCH B—Typical siphon discharge for flood control pump.
High siphon when river is at low level (B)
Low siphon when river is at max. level (A)

One of the early applications of the siphon in a large pumping station is at the Conners Creek Storm Water Plant in Detroit, Mich. Eight units, each of 500 cfs capacity, discharge over siphons into Conners Creek. The up-leg of the siphon is carried above the high-water level in the Creek, and the drop leg is connected to the top of the two discharge conduits, one on each side of the station. An air valve at the top of the siphon opens automatically to break the siphon when the motor is stopped. The City of Detroit has used similar siphons in several of the large pumping stations constructed since the Connors Creek Plant.

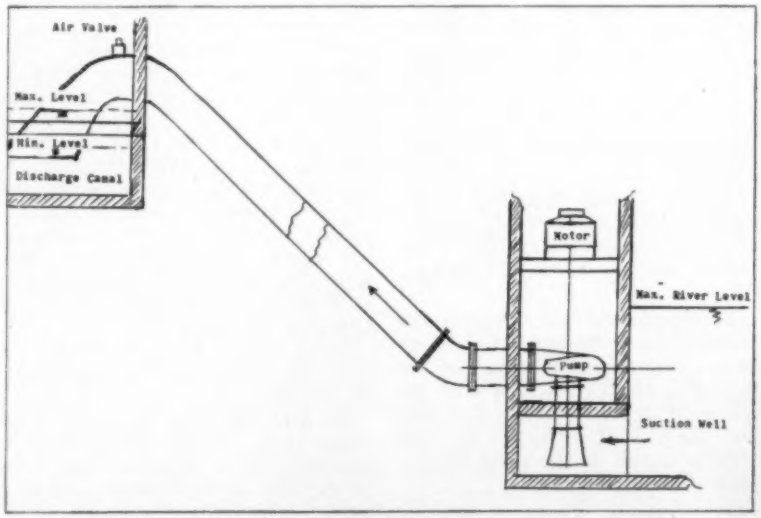
Pumping stations for land drainage frequently are located on the levees protecting land from floods during heavy storms. The pump with its suction and discharge pipes thus forms a siphon (see Sketch B). This type of installation differs from the true siphon in that the water level on the discharge side is higher than that in the suction well, and pumping is needed to produce the flow. Without siphonic action the pumping head would be much higher, and more power would be required to pump the same volume of water. Many plants of this type are in operation in Florida for land drainage. They also are used in the Upper and Lower Mississippi River Valley.

Flood control pumping stations usually are located behind the protecting levee and sometimes the pumping station is made a part of the levee structure. It is the general practice to use vertical shaft pumps and to carry the discharge pipes over a siphon extending above the highest flood level in the river. The drop leg is of sufficient length to be submerged at the lowest river level when pumping is required.

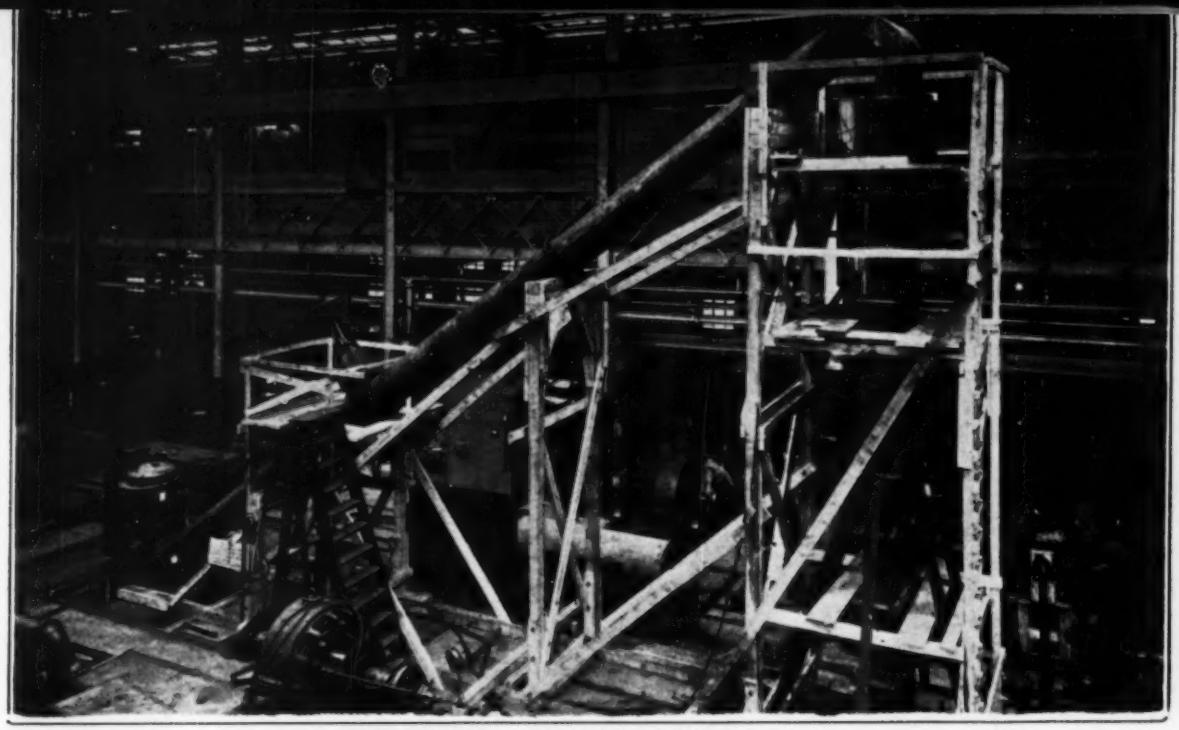
Two pumping stations built by the U.S. Engineers at Memphis, Tenn., have pumps rated at 1000 cfs and 500 cfs respectively. They are designed to pump the runoff of the maximum storm that might occur in twenty years when the river level at Memphis is at maximum flood stage. A heavy local storm may require operation of the pumps with a river level much below flood stage. Thus the static head when pumping will at times be quite low; but the siphon drop leg is long, and it is necessary to maintain a good vacuum to obtain full siphonic action.

A similar flood control plant at the Mill Creek Station in Cincinnati has six units each of 1500 cfs capacity. In this installation is was considered impractical to use the high siphon. A special discharge valve was designed to prevent back flow in the event that pumping is required when the river is at high flood stage. The discharge valve is not needed at low river levels, and is moved into a recess in the top wall of the siphon thus allowing full siphonic action for most of the time when the pumps are operated.

Another interesting application of the siphon to prevent back flow is found in several large pumping plants designed by the Bureau of Reclamation, U.S. Dept. of the Interior, Denver, Colo. The majority of these pumping plants operate at much



SKETCH C—Siphon at end of long discharge pipe pumping from River to high level Canal



TEST SETUP—Beargrass Creek high siphon model on test
Hydraulic Laboratory, Worthington Corp., Harrison, N.J.

higher heads than the drainage and flood control pumping stations previously mentioned. The siphons are low, with less variation in the level of the water submerging the drop leg of the siphon (see Sketch C). They are located at the high end of a long discharge line and are provided with an automatic air valve to break the siphon and prevent continuous back flow when the pumps are stopped. When the siphon breaks, the water in the long discharge line up to the siphon returns through the pump; for that reason, the pumps and motors are designed to operate satisfactorily in reverse rotation while the return water is passing through. The 65000 HP pumps at Grand Coulee in Washington, and the 22500 HP pumps at the Tracy Plant in California have siphons at the end of the discharge line.

The cooling water circulating pumps used for jet and barometric condensers, and for surface type condensers, discharge over siphons. After passing through the condenser the water usually is returned to the source from which it is pumped. The static head is therefore very low; thus the friction through the piping system and the efficiency of the siphon are the principal factors determining pumping head.

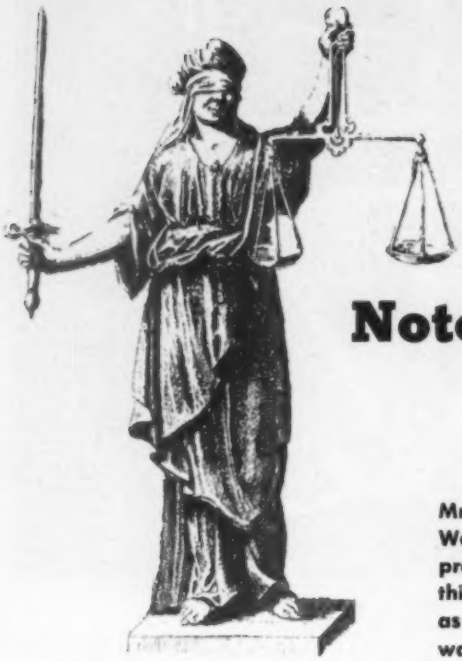
In all plants where siphons are used, the siphon should be well designed in order to obtain full benefit from siphonic action. When operated at low static heads, the loss through the siphon is a high ratio of the total head. If the siphon loss has been underestimated, the siphon may be inefficient and may cause a considerable reduction in the volume of water pumped.

When pumping plants operate over siphons where there is a wide variation of the water level submerging the drop leg, both the pumping head and the capacity of the pumps will vary considerably. In these installations, the siphon must be designed so that it will operate satisfactorily either as a high siphon with low pumping head and maximum flow, or as a low siphon when the pumping head is maximum and the flow is reduced to minimum.

It is not practical to make the usual test of pumping head on many plants having siphons in the discharge line. When the pumps are located at the top of the siphon the discharge gauge will show a vacuum. It has become standard practice to make tests measuring the static head, or difference in level, and for the pump designer to estimate the losses through the system to determine the pumping head for which the pump must be designed.

Like many problems in hydraulics, the testing of homologous siphon models is very necessary to provide the data from which accurate estimates of system losses can be obtained. Models of siphons having all hydraulic dimensions, including the height of the siphon, reduced in the same ratio have been used with fairly good results in the case of low siphons. Such a test does not actually simulate field conditions, especially in the case of high siphons. It does give data on the friction loss through the siphons, but does not give all data needed by an engineer (i.e., the most efficient design of siphon for operation over a wide range of capacity and head, and desirable variation in the length of the drop leg). A model siphon simulating actual field conditions as to height of the siphon, but having pipe sizes reduced in the proper ratio for the flow through the model, is essential for checking accuracy of estimated siphon losses in order to determine the total head for which the pumps must be designed.

The photograph of a test set up illustrates a model siphon being tested at the Hydraulic Laboratory of the Worthington Corp. at Harrison, N.J. The test was made to obtain data for the final design of several pumps having a unit capacity of 950 cfs at 10 ft. head, now under contract for the U. S. Engineer Office, Louisville, Ky. The test was of particular importance because of the great size and extreme height of the siphon. When the pumps are operated with the Ohio River at lowest level, the height of the siphon from the crest to the river level is 29 ft., 2½ in. The ratio of the model to the prototype is approximately 1 to 5. These large pumps will be installed at the Beargrass Creek flood control pumping station in Louisville. In contrast to the pumps at the Mill Creek Station in Cincinnati, the siphons at this plant will extend above maximum flood level in the Ohio River.



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Notes on Water Works Law

by JOHN H. MURDOCH, JR.

Mr. Murdoch is Vice-President and Counsel, Amer. Water Works Service Co., Philadelphia, Pa. He has prepared exclusively for *Water & Sewage Works* this series of articles discussing water works law as it applies to source of supply, water quality, and water distribution.

First Installment—Riparian Rights and Public Water Supplies

THERE are very few instances where water supply agencies seeking new sources of supply or seeking to protect existing sources are not called upon to solve problems arising from conflicts of interest between the agency and those claiming rights in the source of supply. For that reason the law of riparian rights merits first attention.

Riparian Rights

The owner of land bordering on a stream has rights which are part and parcel of that land. Briefly stated those rights are that the waters of the stream come to his land undiminished in quantity and unimpaired in quality subject only to such diminution in quantity and impairment of quality as may result from reasonable uses on the riparian lands upstream. What constitutes a reasonable use will be discussed later. These rights are called riparian rights and are property rights protected by constitutions in the United States against a taking for public use without compensation. The short statement of riparian rights is subject to serious exception in several of our western states. Riparian rights are created by local law and that law in some states where rainfall is normally light has denied to owners of land on streams some of the rights which are traditional in other states. The extent of those exceptions must be made a subject for later development. This section will deal with the common law as it is usually applied.

Riparian rights, as the name in its derivation implies, are rights which attach to the banks of a stream or lake. Ownership of the banks vests in the owner the rights in question. Not all land in a watershed has riparian rights in the stream but only land actually touching the stream. Thus, if one owns one hundred acres of land in one parcel and if a stream runs through that parcel or forms one or more boundaries of it and if all of the parcel is in the watershed of the stream, then all of the parcel has riparian rights and is called riparian land. However, if the owner of the one parcel sells off his land in acre lots, then only the lots which the stream actually touches have riparian rights. *Harvey Realty Co. v. Borough of Wallingford, 111 Conn. 352.* If later the various lots or some of them were again brought into common ownership, then all the new portions of the original tract which are touched by the stream are riparian lands. *Standard Plate Glass Company v. The Butler Water Company, 5 Pa. Superior 563.* A land owner might own a tract bordering on a stream but part of the tract might be outside the watershed of that stream. Only the portion of the one tract which is within the watershed of the stream in question is riparian land of that stream. Further, if two noncontiguous tracts of land in a watershed are in common ownership but only one of the tracts has banks of the stream within it, then only one tract is riparian land. These matters become important in considering the extent of use of the water which would be considered reasonable as a riparian rights of the property owner and in considering damages for infringement of those rights.

Reasonable Use

Owners of riparian lands have the property right to the undiminished flow of the stream and to have the water reach his riparian lands unimpaired in quality subject to the qualification that those rights are subject also to the right of upstream riparian owners to make reasonable use of the water on their riparian lands. This qualification may be thought of as an additional riparian right. Each has the right to have the water reach his land undiminished in quantity and unimpaired in quality and the further right to make reasonable use of the water on his

Author's Preface

These Notes are not intended to be a complete treatise on water works law and are, of course, even less an exposition of the law of waters. They represent rather a setting out of legal principles which the Author has learned while serving as a legal advisor to various public water supply agencies. That professional service has been very largely rendered for privately owned water supply agencies, but in these Notes only matters which are of interest to both publicly and privately owned agencies are to be covered. Thus, there are no discussions of the many legal problems involved in state or municipal regulation of the rates to be charged for service by water companies.

On the other hand it is believed that when it comes to service and to questions of discrimination between customers or between classes of customers the same general legal principles apply to both classes of agencies. There is no purpose to cover the law relative to the organization, internal management or financing of the agencies as the law regarding such matters varies greatly from state to state and could not be satisfactorily covered with anything less than a complete digest of the laws of each state.

To a lesser degree the same difficulty of differences in the laws of the several states is met in considering the subjects which are covered. The reader must be cautioned that the Author has been interested in general principles and theories and that no attempt has been made to check the impact, if any, of state constitutions or statutes on such general principles. Operators and practitioners must follow the custom of the Author in his ordinary work for water companies and investigate the state laws of the state involved to determine whether and to what extent the general legal principles have been modified or completely changed.

In arrangement, the Notes deal first with source of supply, then with water quality, and lastly with distribution. Concerning supply the subjects of riparian rights as affecting the rights of water supply agencies to divert water from streams, of rights in percolating waters as those rights affect the securing of water supplies from ground waters are treated. As to water quality the principles of law applicable to stream pollution and to liability of the water supply agency for injuries due to the serving of contaminated water and such matters are covered. Distribution problems covered include among others, liability for fire losses, discrimination in service, rights in streets and roads, cross-connections with non-potable or non-approved supplies and liability for various acts or omissions in the distribution of water. The last mentioned matter includes discussion of the very interesting questions concerning the circumstances under which an agency is liable in tort for loss due to leaking or breaking mains.

riparian lands. What is a reasonable use must always be determined by judgment after considering all the circumstances in each particular situation. There is never any hard and fast rule or formula that can be applied in all cases. A few illustrations may be helpful. First, however, it must be emphasized that use of the water for or on non-riparian land is never a reasonable use as incident to ownership of riparian lands. Such use for non-riparian lands constitutes an infringement of the riparian rights of downstream owners.

Owners of riparian land may use the water of the stream for domestic purposes in their homes on the riparian lands for their families or guests. This is always a reasonable use. On the other hand, if such an owner established a hotel or resort on the land the use of the water of the stream for serving the added needs might well be considered an unreasonable use unless the flow of the stream was great enough so that even the new use would not materially affect downstream owners. All uses must be considered in connection with the character of the stream involved.

Owners of riparian lands may use the water of the stream for watering live stock even though that use might exhaust the stream. There are cases so holding but it is now suggested that the statement may be too broad. None of the cases which the Author has studied in this connection reveals the facts as to the numbers of live stock or the relation of the numbers to the extent of the riparian lands. On reason it would seem that the stream might reasonably be exhausted in watering live stock sustained in pasturage or forage or grain by the riparian land. However, if an owner undertook to keep herds of live stock on riparian land far beyond the numbers which could be supported by the land, the use might well be considered unreasonable.

When water is used in irrigation of gardens or fields, the water is consumed and is not returned to the stream. In states where the common law rules of riparian rights are the law the question of the extent to which irrigation of riparian lands is a reasonable use and permissable as an incident of riparian rights may be important. During drought periods such use is increasing and has worked hardship on public water supplies in some instances. Each such situation must be considered in the light of its own individual circumstances: the flow of the stream, the extent of the use and the effect of that use on others. Clearly, if the irrigation works substantial hardship or causes a real impairment of the rights of others, the use is not reasonable and so is not within the riparian rights of the person irrigating his riparian land.

Rights and Duties Regarding Riparian Rights

One who has riparian rights has, also, riparian duties. That is since each owner of riparian lands has rights with respect to the stream all the other owners on the stream have the duty to respect those rights. An upstream owner has the duty to permit the stream to flow downstream to his neighbor undiminished and unimpaired except for his own reasonable use. If he does not meet these obligations then he is liable to all the lower riparian owners whose rights he may have invaded. As to those above he has the duty of permitting the stream to flow as it was wont to flow, that is he may not by checking the flow on his own land back water upstream on to his neighbor's land or by interfering with natural flow stop land drainage and create a swamp. In Massachusetts and a very few other states the owners of mill rights are given the right to back water on to lands of upstream owners but the court decisions upholding such rights have been strongly criticized. The common law is to the contrary.

Eminent Domain

Because the term must be used frequently throughout these Notes a few words of explanation may be useful. The right of eminent domain is the attribute of sovereignty by which the sovereign, the state or government takes private property for public use. When private property

is needed for public use and when the private owner is unwilling to sell, the state may exercise its power or right of eminent domain and take the property for public use even against the wishes of the owner. Under our constitutions as well as under common law of England such taking can only take place if the owner be justly compensated for his loss. The question of the need for the property for public use and thus of the exercise of the right of eminent domain is a legislative question. Once the legislative branch has decided that question, the courts have no jurisdiction to pass upon it unless the property owner can prove that the legislative determination involved abuse of power, unreasonableness or bad faith. *Adams v. Greenwich Water Company, 138 Conn. 205; Bridgeport Hydraulic Company v. Rumpsen, 124 Conn. 447.*

What has just been written must be qualified by pointing out that in some states—Maine is one—the legislature has provided that in some instances a court must pass on the question of public need before the right of eminent domain may be exercised. In Connecticut under some special charters for corporations those corporations may exercise the right of eminent domain only if a court found the taking was expedient and necessary. In New York a water supply agency may not exercise its right of eminent domain given it by the state legislature without first securing from the Water Power and Control Commission an order authorizing the agency to exercise its power.

The state is within its rights if it grants to public utility companies or to municipal bodies the right to use the power of eminent domain. It can do so because these companies and bodies are engaged in the performance of public functions, that is, the property which they may take is put to a public use. They are under the control of the state and, as to utilities including water companies, they are required to serve the public and to serve at rates regulated by the government at some level or in some manner. Any property which they seek to acquire by eminent domain must be devoted to public use. In Pennsylvania land acquired by the right of eminent domain by a water company can be owned under such acquisition only until its use in connection with the water works is abandoned. Except to the extent that the courts or other governmental bodies are given jurisdiction to pass on the question of public necessity prior to its exercise the rule is that if the municipal body or the utility declares that it needs the property for public use the courts have no jurisdiction to pass on the question of necessity unless unreasonableness, abuse of power or bad faith be raised by the owner and the burden of proof is on the owner to establish the truth of his claims. In other words, the states have vested in the public utilities or corporate bodies of the state the legislative power to determine the extent of public need. *Bridgeport Hydraulic Company v. Rumpsen, 124 Conn. 437.*

Rights of Municipalities or Water Companies as Riparian Owners

Except where water is secured from wells or is purchased for resale it is very difficult to conceive of how a water supply utility can get a supply of water without having some riparian land. The fact is that most do own riparian land and as such owners have riparian rights. However, they are in a weak position if their only claim to rights and to protection is based on their ownership of land. They would be in much stronger position if their rights were based on their public functions. As lower riparian owners they have the right to have the flow of the stream undiminished and unimpaired in quality but they do not *as riparian owners* have the right to supply the municipality with its homes and industries since most of such supply will go to non-riparian lands. As riparian owners, merely, impairment of the quality of the water reaching their riparian lands would constitute merely grounds for damages or action for abatement of a private nuisance while as public agencies they can validly claim that contamination of their sources of supply will constitute a public nuisance—a much stronger position. However, there are a few cases holding that a municipality in supplying its needs for public water supply exercises riparian rights and its uses are reasonable riparian uses. It is the opinion of the Author that those cases are unsound and that that better rule from a legal standpoint —and also from the standpoint of operations—is that their right to divert water is based on the public use. The cases which are believed to be unsound can in great part be traced back to two old Pennsylvania decisions or rather to chance comments tucked away in those decisions and not points on which the decisions rested. Both of those cases had to do with the use of the waters of the Schuylkill River from Fairmont Dam near where the Pennsylvania Railroad 30th Street Station now stands. The cases have some antiquarian interest as well as legal.

The first is *Mayor, etc. of Philadelphia v. Corporation of Spring Garden and the Northern Liberties, 7 Pa. 348* decided in February 1848. The legislature of Pennsylvania had granted a charter to the Schuylkill Navigation Company authorizing it to build a dam across the river below the falls to establish slack water navigation in the river. The company also had the right to use the flow of the river at the dam for water power subject to certain restrictions. By arrangements with the company, the City of Philadelphia took a supply of water from the pool above the dam. Spring Garden and the Northern Liberties were at the time outside the city and parts of their territory were above the reach of the city's water pumps. The city demanded premium rates. The outside territories secured a charter for a corporation to take water from the Schuylkill and deliver it through their territories. The city sought an injunction to restrain the corporation and the injunction was denied. It was denied on various grounds but chiefly because there was no proof of actual damage to the city. Unfortunately, the Justice who wrote the opinion, Chief Justice Gibson, after throwing in some general comments about riparian rights, made this statement: "The inhabitants of the districts might have lawfully dipped from the margin of the pool, water enough for their several necessities; but instead of drawing it by hand or by horses, they have combined their funds to produce a cheaper and a better transportation. True, they have laid pipes in the pool, as they might have laid them in the bed of the river, had not the dam been erected; but what has that to do with the supposed production of an injury to the complainants by decreasing the volume and power of the stream?"

At other points in the opinion the Justice pointed out that if and when the city could prove substantial damages caused by the diversion by the districts, the city would have the right to recover by suit. The principal ground of the decision, however, as has been stated, was that the city had suffered no actual damage and did not, in fact, own the water. The case certainly is not authority for the proposition that a municipality merely as a riparian owner may supply its needs without liability for damages to others.

The second case was decided in 1871 and also involves Philadelphia's use of water from the Fairmont pool in the Schuylkill River. *City of Philadelphia v. Collins, 68 Pa.*

106. The city took water out of the Fairmont pool for a supply to the city but, also, pursuant to a lease from the Schuylkill Navigation Company used much more water for water power to pump the water from the pool to the city. During a year of low rainfall the city used so much water for water power at the Fairmont Dam that it drew down the water level in the pool to such a low point that slack-water navigation was interrupted. The captain of a canalboat brought suit against the city for loss sustained by being tied up with his boat, cargo and crew at a point above the falls. The water delivered to the city did not cause the excessive drawdown but rather the water allowed to pass over the dam to create power for pumping. The captain, Collins, was allowed to recover damages on the ground that the city had violated its rights under its contract with the Navigation Company and under that company's charter from the state.

On page 123 of the case report this is found: "It was conceded on the trial that upon taking water for the citizens of the city for domestic purposes, no restriction could be placed by legislation or grant, and none was placed. If it could have been shown that it was this supply for domestic purposes only, which occasioned the insufficiency for navigation, then the law of a paramount necessity would have existed and would have brought into play the doctrine of riparian rights, and justified the taking." No exception could be taken to the statement if the writer of the opinion had not used the phrase "would have brought into play the doctrine of riparian rights***." "Paramount necessity" there would certainly have been as the water requirements of a large city would certainly take precedence over navigation. If there were some invasion of the rights of others—certainly in an emergency—law and equity would give more weight to the public needs than to private inconvenience. *Adams v. Greenwich Water Company, 138 Conn. 205.* But to base the position of a city in such a situation on riparian rights is to take a weak and untenable position. Much of the city was non-riparian. And in the earlier case involving Spring Garden—7 Pa. 348—the court had commented that if substantial damage resulted from the use of the water of the river by Spring Garden damages would be proper. Thus Spring Garden's taking would have been a taking for a public use such as is contemplated in eminent domain and not an exercise of a right to use such as is inherent in riparian rights. However, the Collins' decision was not based on riparian rights and the comment on such supposed rights was obiter dicta and not a precedent.

Later the courts of Pennsylvania gave some consideration to these earlier Philadelphia cases and, in effect, limited their impact on the law to public or navigable streams and emphasized the thought that anyone having access to a public stream could use water from it. The court did not comment on the question whether the taker would be liable to damage or to restraint by injunction if the taking from a public stream worked substantial injury to riparian owners. As we have seen the implication of the Spring Garden dicta is that such liability would exist. The later case referred to did not involve a navigable stream and the municipality was not located, even in part, on riparian lands but it was a riparian owner and that fact was given great weight by a master appointed by the lower court on the supposed authority of the Philadelphia cases. The ground did not impress the lower court. It was brushed aside by the Supreme Court. *Haupt's Appeal, 125 Pa. 211,* decided April 8, 1889. Facts: Borough of Ashland in 1876 became the owner of a tract of land on Little Mahonoy Creek, erected a dam to impound water and a pump station by which it pumped water through several miles of transmission main to the Borough for public water supply. Later Haupt started to erect a dam and pumping station on his land upstream from Ashland's land for the purpose of supply water to the Borough of Frackville. The creek was not large enough to supply both Ashland and Frackville.

Ashland sought and secured an injunction restraining the threatened diversion.

In the lower court a master appointed by that court submitted a report recommending an injunction principally on the ground that the upstream diversion would interfere with the rights of Ashland as a riparian owner. Both the lower court and the Supreme Court of Pennsylvania were of the opinion that the ground stated was too narrow. The Supreme Court said: "If the authority of the plaintiff (Ashland) were measured by its rights as riparian owner it would be slender enough. It might indeed use the water for domestic purposes incident to the said ten acres of land. (Ashland owned ten acres on the creek.) If there was a tenant thereon he could use it for watering his stock and for household purposes; for any useful, necessary, and proper purpose incident to the land itself and essential to its enjoyment. But that the rights of a riparian owner would justify the plaintiff in carrying the water for miles out of its channel to supply the borough of Ashland with water, is a proposition so palpably erroneous that it would be a waste of time to discuss it."

The Supreme Court then found that the rights of Ashland were based on its statutory power to take land and waters for a public supply subject to the constitutional mandate to make compensation for any private property taken by proceeding under the right of eminent domain.

The dicta in the early Philadelphia cases were considered authority in the Ohio case of *City of Canton v. Shock, et al. 66 Ohio St. 19,* decided February 25, 1902. Shock was the owner of a water power mill on Nimisheller Creek. The City of Canton is located between the two upstream branches which unite to form that creek. The city, at the time of the case, took water from one of the branches and, at certain seasons, its uses of water from the branch caused such diminution of flow at the mill of Shock as to interfere with its operation. Shock sued for damages and the city defended on the ground that *as*

a riparian owner it had the right to use the water of the stream for supplying the water needs of the city *without making compensation* to Shock. One of the main supports for this conclusion was the supposed position of the courts of Pennsylvania as set out in the Philadelphia cases without noting the fact that at least the earlier of those cases mentioned the possibility of damages and that the later case did not mention that matter.

While stating that the use by the city must be reasonable considering the size of the stream and while holding that in time of drought both the city and Shock must suffer some curtailment, the court did sustain the essential element of the city's position that its taking was an exercise of its claimed riparian rights. In its discussion the court seems to hold that a lower riparian owner taking action to protect his riparian rights would be limited to proceedings against upper riparian owners. Since it is possible to conceive of conditions where pollution or diversion of a stream might be caused by one in no sense a riparian owner, the court's reasoning is impossible to follow.

It is the Author's opinion that the reasoning and conclusion of the Ohio court should not be adopted. A taking for a supply of water to a municipality should be governed by the principles applicable to a taking for a public use and, if necessary, eminent domain rights should be exercised.

In Illinois there is the case of *City of Elgin v. Elgin Hydraulic Company, 85 Ill. App. 182,* decided October 12, 1899.

The Hydraulic Company was incorporated to maintain and operate a mill race on the Fox River in Elgin. The company did not own the race or the dam and was not a riparian owner. The city owned land on the pool above the dam and took water out of the pool for public water supply purposes and this diversion at times lessened the amount of power which could be generated at the dam. The company asked damages.

The court held that the company had suffered no loss since it did not own the race or the dam and was not a riparian owner. It then went on and stated that the city was a riparian owner and that the city is "entitled to the use of its proportionate share of the waters of the river." This statement is obiter dicta as the point was in no way essential to the court's ultimate conclusion. If the court meant that the city as a mere riparian owner could take water for all the needs of the city when much of the land in the city was not riparian it is the opinion of the Author that the position is unsound.

There is a New York case which sets forth the sound law on the subject—*Sumner v. City of Gloversville, 71 N. Y., Supp. 1088,* decided July 1901. The City of Gloversville, under legislative authority, had impounded certain streams tributary to a river for the city's water supply. Thirty-two miles below the point of impounding a manufacturer had property on the main branch of the river and used water from the river for water power. At low water in the river the amount flowing at the manufacturer's plant was one thousand times the amount diverted. The manufacturer brought suit against the City of Gloversville to recover damages for diversion of the water of the river basing his action on his rights as a riparian owner. The court dismissed the complaint on the ground, inter alia, that the manufacturer had not suffered substantial damage. *The court held that the diversion was for a public use but that if substantial damage had been done, the city would have been liable for damages.* There is an excellent exposition of the law on this point and parts of it are quoted below.

From page 1090—"***** I think the plaintiff, as riparian owner, even if the Sacandaga river be construed to be a public stream, and the title to its bed in the people, has the right to have the water flow past his premises, and has the right to use the water as against every one except the people of the state, and as against them even, only that he shall not interfere with public navigation; and that the legislature had no authority to give to the defendant the privilege of unlawfully diverting the head waters of any of the tributaries of the river.****. Even if it be treated as a purely navigable river, the bed of which is owned by the people of the state, it is no defense to a person doing injury to a riparian owner's rights. *Palmer v. Mulligan, 3 Caines, 311, 2 Am. Dec. 270.*"

"The right to use water as it flows is a property right, yet the water itself is not the subject of exclusive ownership or dominion either by the sovereign power or an individual. *Sweet v. City of Syracuse, 129 N. Y. 335, 27 N. E. 1081, 29 N. E. 289.* Riparian owners, therefore, upon navigable streams even, as against other individuals, have the right to use the water as it flows past their premises; and whether a dam or other structure is a public nuisance is not for the wrongdoer to say, but that question is between the people and the riparian owner. *Stiles v. Hooker, 7 Cow. 266; Harris v. Thompson, 9 Barb. 350.*

"Even if the defendant was authorized by act of the legislature specifically to take the water of some of the tributaries of the Sacandaga river, this would be unavailing as a defense to an invasion of the rights of the plaintiff, because the state has no right to convert the waters, or authorize their conversion, for any other use than the purposes of navigation. *Smith v. City of Rochester, 92 N. Y. 464, 44 Am. Rep. 393.* I think the case at bar, therefore, is to be passed upon irrespective of whether the state owns the bed of the Sacandaga, or whether the legislature, owning the bed of the river, authorized the defendant to appropriate for its water system some of its tributary streams; and the question is, whether or not the taking of one one-thousandth part of the water of the stream upon which the plaintiff's dam is situated, under all the circumstances disclosed, is such a perceptible and material diminishing of the flow as will compel the court to recognize it, and award damages therefor. *****"

Here it was held then that a public use taking of riparian rights in the flow of even a navigable river would make the taker liable for damages if substantial injury be done. This is sound.

Other interesting cases sustaining the position that a substantial infringement of the riparian rights of downstream owners, for a public use, cannot be done merely on the basis of ownership of upstream riparian lands and that compensation must be made are: *Gardner v. Trustees of the Village of Newburg, 2 Johns Ch. 162,* decided in 1816 by Chancellor Kent; *Harding v. Stamford Water Company, 41 Conn. 87,* decided in 1874; *Lord v. Meadville Water Company, 135 Pa. 122; Philadelphia and Reading Railroad Company v. Pottsville Water Company, 182 Pa. 418,* decided October 11, 1897; and *Pennsylvania Railroad v. Miller, 112 Pa. 34,* decided February 8, 1886.

(The First of a Series)

W&SW

Pumps—Types and Principles

The Sixteenth of a Series

by GEORGE E. SYMONS, Ph. D.
Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

A LIQUID will move from one level to a lower level under the influence of gravity, but cannot move from one level to a higher level without energy being expended to move it. Electricity, steam, petroleum product combustion, waterfall or wind pressure may be the source of power, but the device which actually moves the liquid is a pump. In short, a pump is a device which will receive a fluid from some source and discharge that fluid to a higher elevation, or at a higher pressure.

A . . . Reasons for Pumping

1. GENERAL

a. To lift water from a surface source of supply (river, reservoir or lake) to a treatment plant, or to lift water from wells to treatment plant, reservoir, or distribution system.

b. To deliver water to the consumers' taps

2. SPECIFIC

a. To supply fire pressure

b. To boost line pressures at booster stations and fill elevated tanks

c. To move chemical solutions or slurries from storage to dosage points

d. To back-wash filters or fill back washing elevated storage tanks

e. To provide air for back-washing filters

f. To dewater tanks, basins, sumps, etc.

B . . . Types of Pumps

1. CLASSIFICATION BY OPERATING PRINCIPLE

a. Displacement—Reciprocating
(1) Piston
(2) Plunger
(3) Diaphragm

b. Displacement—Rotary
(1) Gear
(2) Lobe
(3) Screw
(4) Moyno
(5) Sliding Vane
(6) Miscellaneous

c. Centrifugal
(1) Volute
(2) Diffuser
(3) Turbine
(4) Mixed Flow
(5) Propeller or Axial Flow

d. Ejector or Jet

e. Air Lift

f. Hydraulic Ram

g. Aorta

2. CLASSIFICATION BY USE

a. Low Service
b. High Service
c. Deep Well
d. Boiler Feed
e. Sewage & Sludge
f. Proportional Feeders

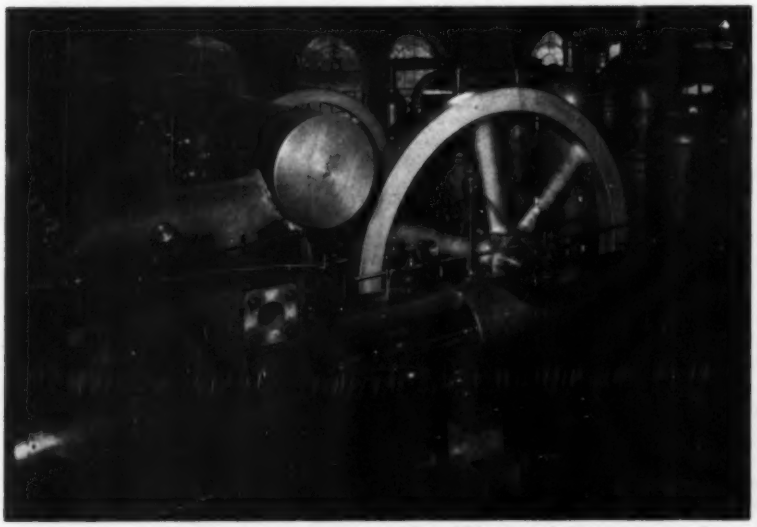


Fig. 1—STEAM pumping engine to move water

C . . . Principles of Operation

1 . . . DISPLACEMENT—RECIPROCATING

a. Water flows into the pump chambers (a confined space), under the influence of a partial vacuum created by the withdrawal of a movable object, which, on its return into the pump chamber, forces the water out. Chamber inlet and outlet valves operate in conjunction with the motion of the movable part.

b. Reciprocating pumps are essentially a closed cylinder containing a piston or plunger as the displacing mechanism.

(1) When the piston acts on the liquid in one end of the cylinder, it is a

single action pump.

(2) When the piston acts on both ends of the cylinder, it is a *double action pump,* and a more or less constant discharge is produced.

(3) Most steam pumping engines, which were installed about the turn of the century, were double-action duplex pumps with two sets of cylinders; some were double-action triplex. Either type produces a continuous discharge, and both were usually equipped with air chambers on the discharge to aid in an even rate of discharge (Fig. 1).

c. *Piston pump.* A reciprocating pump wherein the cylinder is tightly fitted with a reciprocating piston.

d. *Plunger pump.* A reciprocating pump with a plunger that does not come in contact with the cylinder walls, but enters and withdraws from the cylinder through packing glands. Modern deep well plunger pumps are a refinement of the old wood-cased hand pump used in country home or farm wells.

e. *Diaphragm pump.* Contains a flexible diaphragm usually of rubber, as the operating part, fastened at the edges in a cylinder. When it moves in one direction suction is created in the cylinder; when it moves in the other direction the liquid is forced out through a discharge valve.

2 . . . Displacement—Rotary

a. In rotary pumps the elements rotate in a pump case which they closely fit. Rotation alternately draws in and discharges water being pumped. Neither suction nor discharge valves are used. It will operate at almost any speed and does not depend on centrifugal forces to lift the water.

b. Rotary pumps combine the constant-discharge characteristic of centrifugal pumps and the positive-discharge feature of reciprocating types.

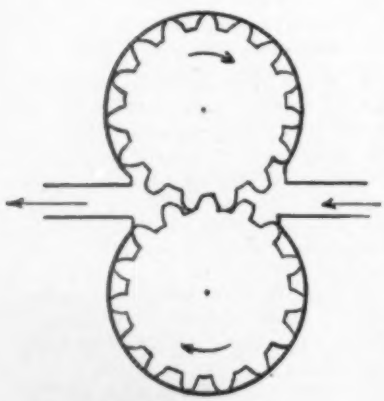


Fig. 2—GEAR pump

c. *Gear* Rotary Pumps include: two external spur gears; two spiral gears; two herringbone gears; and external-internal gears.

(1) One gear is the driving gear, the other the idler gear. Both have very close clearances with the casing.

(2) Where the gear teeth contact, they form a fluid-tight joint. Liquid flows between the gear teeth on the suction side, is trapped between the teeth and the casing, and is carried around to the discharge (Fig. 2).

d. *Lobe-type* rotary pumps may be two or three lobes. (Fig. 3).

(1) Lobe pumps operate like gear pumps except that the liquid is in a smaller number of large quantities.

(2) Flow from a lobe pump is not as constant as from a gear pump.

(3) Combination gear and lobe pumps are used for water supply, fire duty, and sprinkler service in mills and factories where positive capacities up to 500 gpm and heads to 100 psi are required. They usually are driven by gears outside the pump casing.

e. *Screw pumps.* Consist of meshing helical rotors. They can be used for pumping liquids at high discharge pressures up to 4000 gpm, but are not commonly used in water works.

f. *Moyno pump* (Fig. 4). A special type of screw pump; it consists of a single threaded rotor (of bronze or heat-treated steel) operating with practically no clearance in a double-threaded helix of soft or hard rubber, depending on the pressure desired.

(1) It was named phonetically for its inventor, R. J. L. Moineau and is known as a "progressing cavity" pump.

(2) The rotor has an eccentric rolling motion; as it rotates in the stationary double helix, it maintains sealed contact throughout its length and produces an advancing positive displacement from suction to discharge.

. . . It will pump in either direction depending on direction of rotation. It is useful for sampling liquids containing solids and for pumping chemical solutions and slurries.

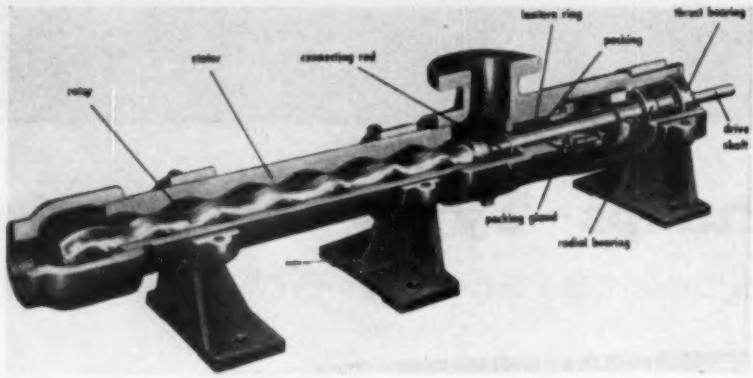


Fig. 4—MOYNO pump (special type of screw pump)

g. Miscellaneous types of rotary positive displacement pumps include: Sliding vane, roller-type, swinging vane, rollway, rotary plunger, roto-piston, and universal-joint pumps.

Most of the rotary pumps are infrequently used in water works but are used for pumping viscous liquids, or for extremely high pressures or extremely high volumes at low heads.

3 . . . Centrifugal Pumps

a. In simplest form, an impeller with vanes rotates in a volute (spiral) casing (Fig. 5). Liquid entering at center of the impeller is picked up by the vanes and accelerated to a high velocity by rotation of the impeller and discharged by centrifugal force. As the liquid is forced away from the center, or "eye" of the impeller, a vacuum is created causing more liquid to flow in. Flow is constant.

b. Centrifugal pumps are simple in design, low in cost, and able to operate over a wide variety of conditions including high discharge heads and high

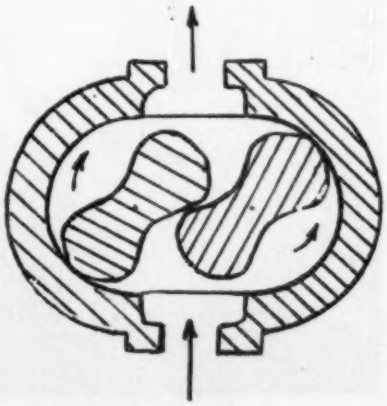


Fig. 3—LOBE pump

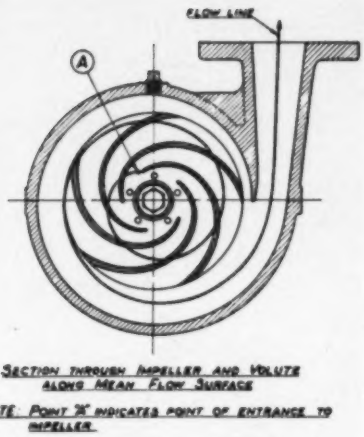

FLOW LINE
A
SECTION THROUGH IMPELLER AND VOLUTE ALONG MEAN FLOW SURFACE
NOTE: POINT "A" INDICATES POINT OF ENTRANCE TO IMPELLER

Fig. 5—VOLUTE type centrifugal

temperatures. They will operate at standard speeds for electric motors and turbines and can be throttled without building up excessive pressure or overloading the driving unit.

c. *Volute pump.* The most commonly used, it is strictly a centrifugal type pump, with the impeller discharging into a progressively expanding spiral casing. The proportions of the casing are designed to produce equal velocity of the liquid all around its circumference; the velocity of the liquid is gradually reduced as it flows from the impeller to the discharge, thus changing velocity head into pressure head.

d. *Diffuser type centrifugal pumps* (Fig. 6). Also a true centrifugal pump; the runner (impeller) is surrounded by gradually expanding passages formed by stationary guide vanes. In these passages, the direction of flow is changed and velocity head converted into pressure head before the liquid enters the volute.

These pumps are slightly more efficient because the velocity head is more completely converted to pressure head, but they are more complicated in design and cost more than volute pumps. The diffuser pump (sometimes mistakenly called a turbine pump) is usually justified where high pressures are desired.

e. Centrifugal pumps are made in many designs and arrangements including: single stage-single suction; single stage-double suction; and multistage pumps (2, 3, 4,); split case, close coupled, horizontal, vertical, etc.

f. Multistage pumps are used where a single stage will not develop the desired head. In this type of pump, two or more impellers operate in series, with the discharge of one connected to the suction of the next. The impellers are all operated on the same shaft.

g. *Turbine pumps.* Differ from true centrifugal pumps in the design of the impeller. Turbine pump impellers have a double row of vanes in the rim and these vanes rotate in a channel in the pump's casing.

Liquid enters at the suction (Fig. 7) and is picked up by the vanes, makes almost one complete revolution and is discharged at high velocity. Because of the action of the water in the vanes, this pump has the same effect as multistaging, and high pressures can be developed.

h. *Mixed flow pumps.* Develop head partly by centrifugal force and partly by the lift of the vanes on the water. They have a single inlet with the flow entering axially and discharging in an axial and radial direction into a volute type casing.

i. *Propeller or "axial flow" pumps.* Develop most of the head by the propelling or lifting action of the vanes

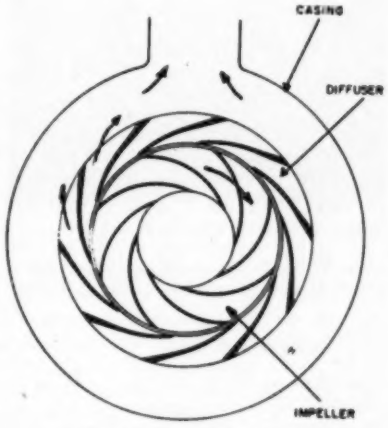


Fig. 6—DIFFUSER type centrifugal

on the water. They have a single-inlet impeller with the flow entering axially and discharging nearly axially into a guide case.

4 . . . JET PUMPS

a. An ejector, is the simplest form of a jet pump. It consists of a nozzle which discharges air, steam or water into a constricted throat which leads from a suction pipe. The ejector is used to move sand from filter beds, to dewater trenches, to dissolve chemicals, and to move slurries, etc.

b. The jet principle is applied to deep well pumps in combination with a single stage centrifugal pump at the top of the well (Fig. 8).

(1) From 35 to 50 per cent of the discharge goes into the ejector nozzle.

(2) The efficiency of the ejector is 15 to 30 per cent, but the combination can be used to lift water 400 ft compared to 15 to 20 ft for the centrifugal pump alone.

(3) These pumps usually are used for lifts greater than 25 ft and net discharges of 50 gpm or more.

5 . . . AIR LIFT PUMPS

a. Air discharged in fine bubbles, under pressure at the bottom of a well, will mix with the water and reduce the apparent specific gravity of the air-water mixture. Pressure on the surrounding water causes the mixture of air and water to rise in the discharge pipe to the outlet (Fig. 9).

b. Efficiencies commonly run from 30 to 50 per cent, and will depend on the submergence and condition of the equipment.

c. Per cent submergence of the air pipe in the water is calculated according to the formula

$$\% \text{ Sub.} = H_s/H$$

Where H is the total distance from air discharge outlet to well discharge and H_s is the distance from the pumping level to the air outlet.

The greater the total lift from pumping level to well discharge, the less the required per cent submergence.[3]

Lift — ft	% Submergence
50	70 to 66
50-100	66 to 55
100-200	55 to 50
200-300	50 to 43

d. Air required per gallon is estimated as follows[3]

$$V = \frac{H_z}{C \log [(H_s + 34)/34]}$$

Where V is cfm of free air per gallon of water raised; H_L is lift in feet; H_s is submergence in feet, and C is a constant given by Steel in the table on the following page:

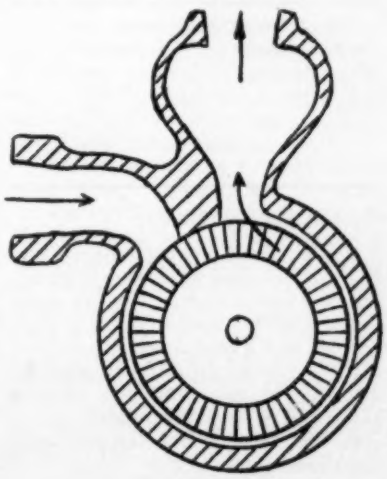


Fig. 7—TURBINE pump

Fig. 8—JET pump

Constant Force Submergence	
% Submergence	Constant—C
75	366
70	358
65	348
60	335
55	318
50	296

6 . . . Hydraulic Ram

a. This is an impulse pump, (Fig. 10) used in small water supply installations where a large volume of water at some head is used to pump a small volume to a higher level.

b. The hydraulic ram will work on 3 ft of head, but works best where a 12 ft head or more is available.

c. The formula for the hydraulic ram discharge is

$$q = (QH/h) \times e$$

where q = gpm of water raised

h = height water is raised above ram

Q = gpm of water used by ram

H = working fall, feet

e = efficiency (average value 0.6)

7 . . . Aorta Pump

a. Developed on the principle of the heart, a soft rubber tube is alternately squeezed and released at two or more different points, with the result that the liquid is moved from one "cavity" to another in pulsations.

b. The aorta pump finds application in sampling operations, and in pumping small volumes of chemical solutions and slurries.

D . . . Power for Pumping

1 . . . Sources

a. Electricity, steam, gasoline and diesel engines are used as sources of power for operation of reciprocating, rotary and centrifugal pumps.

b. The simple jet ejector is operated by water, air or steam under pressure; the air lift pump by air under pressure, and the hydraulic ram by water under an elevation head.

c. Windmills can be used for operation of plunger pumps on small wells.

2 . . . Standby Power

a. According to the AWWA Manual of Safe Practice in Water Distribution, "All main pumping stations should be provided with auxiliary sources of power sufficient to maintain operations in case of interruption of the primary power source."

b. Standby power may be in the form of separate source of electricity, direct connected gasoline or diesel engines to centrifugal pumps, or diesel or gasoline engine driven generators.

3 . . . Choice of Power

a. In the hey-day of the giant steam pumping engine, steam was the only source of power and steam boiler plants were an integral part of any water works. Modern centrifugal pumps have outmoded steam pumping engines and steam turbine driven centrifugal pumps.

b. Electric power is low in first cost and has other advantages although it requires standby power sources.

Fig. 9—AIR-LIFT pump

c. Diesel engines are reliable and economical but their speeds are too low for direct connection to centrifugal pumps.

d. Gasoline engines can be used for direct connection to centrifugal pumps operating at moderate heads, but need a reducing gear for low pumping heads. They are generally not considered as economical for continuous duty.

e. Air lift deep well pumps must be supplied with air under pressure from a compressor powered by electricity, gasoline or diesel engine.

E . . . References

Material for this lecture was obtained from these sources:

1. Kristal, F. A. and Annett, F. A. "Pumps" (McGraw-Hill).

2. Hardenbergh, W. A. "Water Supply and Purification" (Int. Textbook Co.).

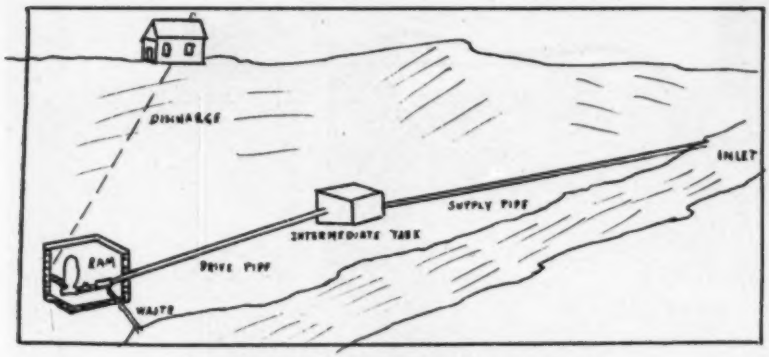


Fig. 10—DIAGRAM of hydraulic ram arrangement

3. Steel, E. W. "Water Supply and Sewerage" (McGraw-Hill).

4. A.S.C.E. et al "Glossary of Water and Sewage Control Engineering".

For detailed discussions of centrifugal pumps see: "Basic Factors in Centrifugal Pump Applications" by Carter and Karassik. (Parts 1-6)—*Wat. & Sew. Wks.*, 100, R-23 (May 1954).

NEXT LECTURE

PUMPS — APPLICATIONS, SELECTION, OPERATIONS.

W&SW

Andress Heads Water Dept. of Newark, N. J.

George W. Andress was recently nominated to the position of Chief Engineer and Director of Public Works for the City of Newark, N. J. He will be head of the department that includes five divisions: engineering, sanitation, water supply, public property and the division of motors.

Andress is the dean of the city's engineering forces in point of service, with 40 years of continuous service, having joined the city in 1914 as a paving inspector. He received his engineering degree from Cooper Institute of Technology. Mr. Andress holds membership in several Engineering and Public Works organizations.

Bulletin on Dolomitic Lime For Waste Treatment

The Finishing Lime Assn. of Ohio has published a brochure titled "Treatment of Trade Waste with Dolomitic Lime." This eight-page Bulletin No. 2 cites "Case Histories" giving details of the use of lime for treatment of plating wastes, plating and pickling liquors, and oil and water emulsions.

Copies of the bulletin may be obtained from The Finishing Lime Association of Ohio, 240 Huron Street, Toledo 4, Ohio.

Edward Wright Retires from Mass. Dept. of Health

The above photograph shows Edward Wright receiving from Governor Christian A. Herter (left) the congratulations and thanks of the Commonwealth of Massachusetts. Mr. Wright retired recently after more than 47 years of service with the Department of Public Health.

He first entered the service of the state in 1906 with the then State Board of Health. Since 1930, he has been in charge of sewage disposal from the Division of Sanitary Engineering. While he was required to retire from the health department at the age of seventy, he is continuing as chairman of the State Reclamation Board.

Bird Fight Shuts Off Town Water Pumps

Noblesville, Ind., went without normal water service for two hours recently thanks to a pair of belligerent birds.

Utility repairmen reported a blown fuse which shut off water station pumps was caused by fighting birds crashing into an electrical transformer.

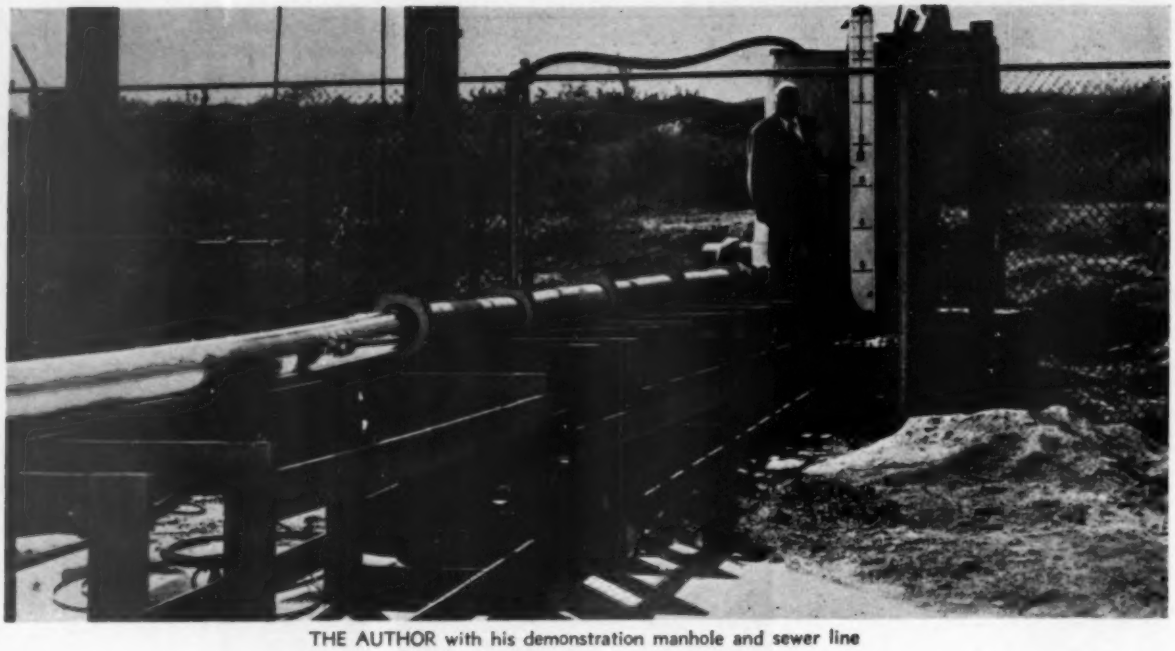
Although power was restored quickly, it took two hours to build pressure in the water system up to normal for the city.

Col. Browne Keynote Speaker at Interamerican Congress

The Address of Welcome, in the name of the English speaking members of the 4th Interamerican Congress of Sanitary Engineering, was delivered by Col. Thomas P. Browne, Export Manager, The Permutit Company, New York, N. Y., at the recent sessions of the Congress at Sao Paulo, Brazil.

Col. Browne is the present President and a founder member of the Interamerican Association of Sanitary Engineers of the United States, an organization having some 2,000 members throughout the 21 republics of the Western Hemisphere. He is a graduate Chemical Engineer and licensed Professional Engineer, and is the author of numerous papers on sanitary engineering problems.

"As a consequence of city industrialization," stated Col. Browne, "rivers and streams are being used to discard waste materials, which in turn destroy animal life and contaminate the water with resulting danger for human health. In almost any city or rural area in the world, there is a problem concerning water purification or potability, or treatment and disposal of sewage. With modern methods, it is often possible to correct these deficiencies."



THE AUTHOR with his demonstration manhole and sewer line

The Sewer Cleaning Ball in Action

Clear plastic pipe revealed the effect of pressure variation and made it possible to develop an efficient tool

by **SIDNEY PREEN,** ***Superintendent of Sewer Maintenance***
City of Long Beach, Calif.

AT A RECENT MEETING of the Los Angeles Section, California Sewage and Industrial Waste Association, nearly one hundred sewer maintenance specialists witnessed a demonstration of sewer cleaning in what may be the most unusual sewer manhole and sewer pipe line in existence.

The unusual manhole and pipe line is an in-service training aid developed and built by the Long Beach Sewer Maintenance Division. It is a standard manhole approximately five and one-half feet deep, built on a platform approximately three feet high. The opening is accessible only by ladder. From the manhole lead four clay stubs of varying sizes. On the six-inch stub there has been constructed a sixteen-foot clay line fitted with ceramic weld flexible collars. At the end of the clay pipe is a twenty-foot joint of clear plastic pipe. The purpose of this training aid is to demonstrate visibly to sewer maintenance crews the effectiveness of the sewer cleaning ball.

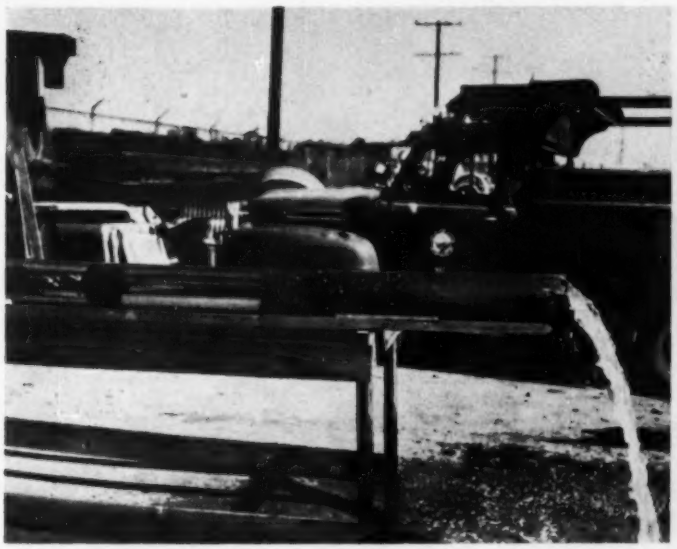
The sewer ball in use in the City of Long Beach has been developed after many years of experimenting with all types of hydraulically propelled sewer cleaning equipment. Originally, the ball was a makeshift arrangement utilizing a soft rubber beach ball covered with burlap sacking. This was subject to puncture by solid material found in sewers, and was not dependable or efficient. To overcome punctures, a tougher, specially-compounded rubber ball was developed. The wall thickness of the new ball was designed to withstand most foreign objects in the line. As a further development, ribs were added which were intended to act as squeegees against the inside diameter of the pipe.

We were not able to tell for sure just what the action of the ball in the line was until this unusual clear plastic line was installed. Experimentation with the ball in the plastic line, with varying heads of water and with various pressures in the ball, has enabled us to develop a tool that is efficient and effective in ridding underground lines of almost all common obstructions.

See What Happens

The principle involved is extremely simple. A head of water is allowed to build up in the upstream manhole until sufficient force has been developed to cause a high velocity stream of water to pass around the periphery of the ball, forcing all the accumulations of the settleable solids ahead of it; while at the same time scouring and scraping the interior diameter of the pipe.

Because of its versatility and dependability, it has become the standard maintenance tool in the Sewer Maintenance Division in the City of Long Beach, and has enabled this City to engage in a sewer maintenance program which is economical and effective. Stop-



PRESSURE caused by the ball suspends heavy debris.

DEBRIS flushed out by pressure as ball leaves the line.

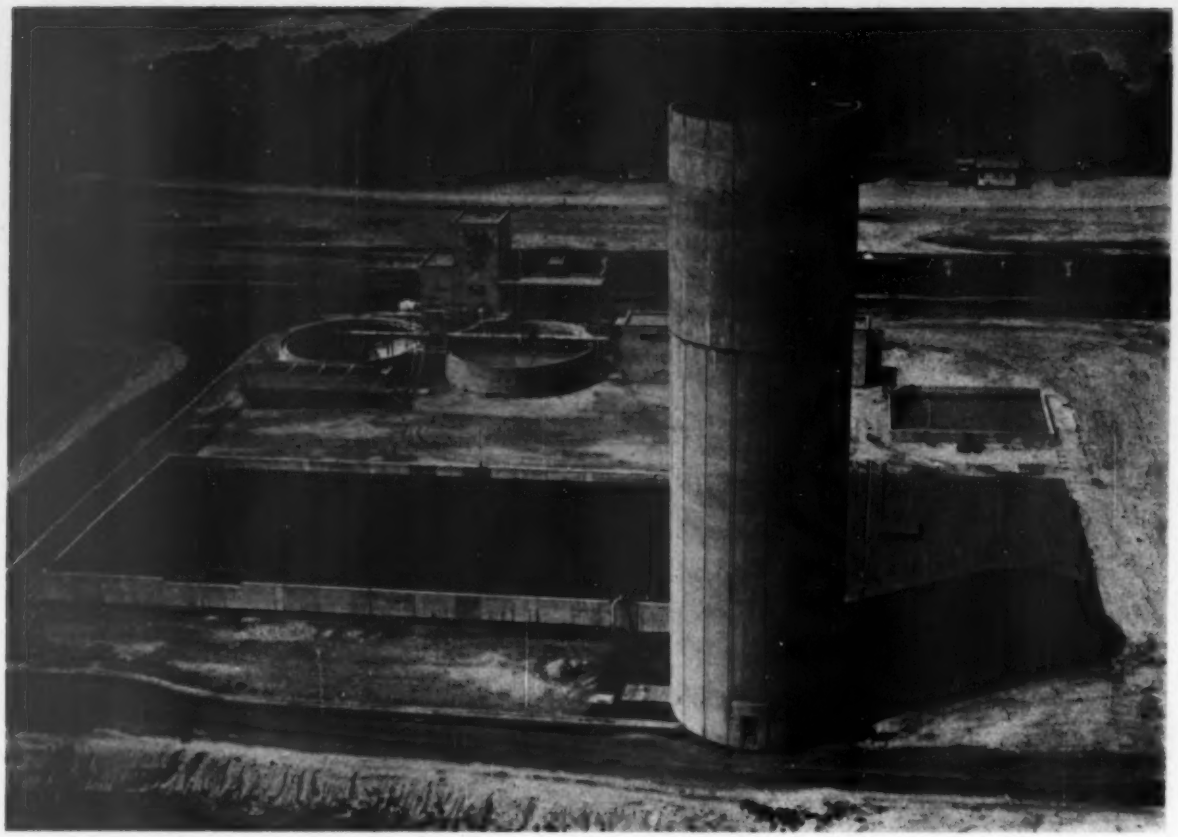
pages have been reduced ninety per cent, and complaints of odors have been reduced almost ninety-five per cent. It has been proved through chemical testing on the job that a line cleaned by the Wayne Ball has been completely freed of sulphide-generating slimes.

Sewer Maintenance Group A Working Organization

The Maintenance Section is a branch of the California Sewage Works Association, which was organized by a group of non-technical members. It is primarily a working group engaged in the actual maintenance of sewer systems. Since its organization eighteen months ago, it has grown to a point where now there are nearly as many members in the Maintenance Section as there are in the entire Sewage Works Association.

W&SW

DEMONSTRATION of the cleaning ball before members of the Maintenance Section, California S. & I.W.A.



KAISER'S water treatment plant, industrial reservoir (open), domestic reservoir (covered), and water tower

How Reclamation Reduces

Kaiser Steel Co. at Fontana, California, requires 144 million gallons of water per day but uses only 2.5 mgd of fresh water

by JAMES JOSEPH

UNLIKE any other major steel mill, the Kaiser Steel Corp. plant at Fontana, Calif., is located inland, miles from any large body of water. Not even a river or an outfall for waste water disposal is nearby. The plant site was selected because of near-at-hand deposits of iron. But while there is plenty of high grade ore, water in the quantities used for steel production is in short supply. So Kaiser engineers designed into the plant what probably is the most efficient waste water reclamation system in the United States. Key to this system is water reuse—achieved by removing and recovering chemical contamination.

Most big U.S. steel mills report using up to 230 million gallons of water per day. In many cases this figure represents water actually used and discarded. The Kaiser plant requires only 2.5 million gallons of make-up water each day, although some 144 million gallons are recirculated during its three daily shifts.

Or, put another way, the national average for water consumption per ton of steel produced is about 65,000 gallons. Kaiser uses only about 1,400 gallons of new water and recirculates 50,000 gallons for every ton of steel produced. Overall, its reclaiming system requires but 1,400 gallons of new water per ton of steel.

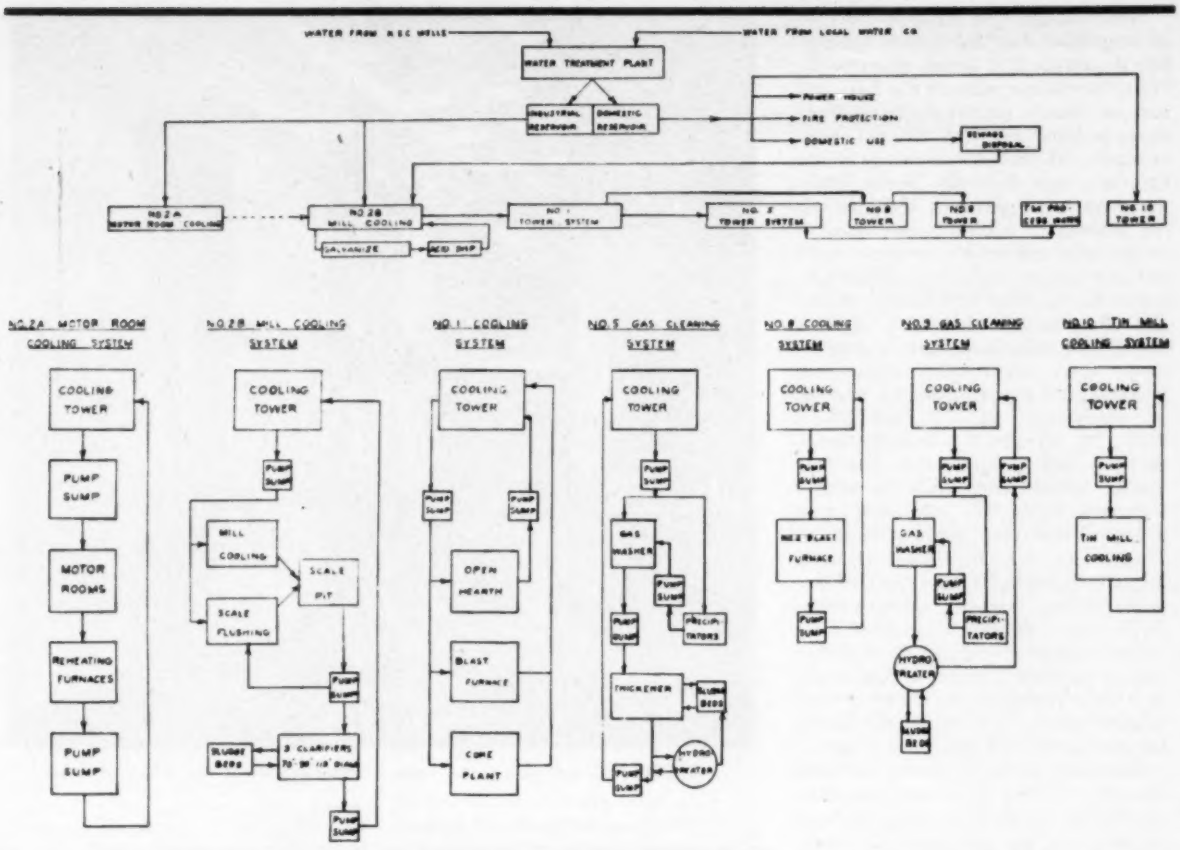
The problem from the outset was basic: How to purify and reclaim water from one process to another.

Mr. Joseph is Bureau Chief of "Western Roundup", specializing in technical articles concerning industry located in western states.

Solving the Problem

Built into the Kaiser plant is a series of 7 cooling systems,, illustrated diagramatically in Fig. 1. Each cooling system is keyed to a major producing unit within the plant. The blow-down from one system thus becomes the supply for the next.

New water comes to the Kaiser's



SCHEMATIC layout illustrating re-use of water in seven interconnnected systems

Steel Plant's Water Make-up

water treatment plant either from a local water utility or from one of the company's two wells (each of 2,000 gal. per min. capacity). After removal of solids by coagulation with lime and sodium aluminate, water flows into either an industrial or domestic reservoir. The domestic reservoir makes up waste deficiencies in the No. 2A motor room supply and No. 2B mill cooling tower systems. The blow-down from No. 2A supply becomes additional make-up water for No. 2B system. As the process continues, the blow-down from No. 2B becomes make-up for No. 1, and so on through the system.

Each cooling system, beginning at No. 2A and extending through final use in No. 9 system (which is tin mill processing), uses water progressively more highly contaminated. However, throughout the system are various clarifiers to remove the most harassing chemical contaminates.

Let's look at a single system: the No. 2A cooling system consists of cooling towers and pumps. Its capacity is 15,000 gal. per minute. This water cools the motor rooms and electrical equipment, including several 5,000 h.p. motors. After passing through the motor rooms, water cools skids of the reheating furnaces and then discharges into a pump sump from where it is pumped over the cooling towers to start another cycle. Threshold amounts of phosphate are used to control scale conditions in this particular system.

Cooling system No. 2A illustrates how tower efficiency has been raised to a maximum so that as little as one-half of one per cent make-up water is required per circulated gallon.

Series Flow Through Units

Series flow is the key to this and other Kaiser tower systems. This means that water progressively picks up heat in moving from cooler to hotter processes. Series flow means much greater efficiency.

Typically, an original installation of fans and turbine drives was equipped with water-cooled bearings and oil coolers. Each bearing or cooler had its individual water supply—7 to 10 different hook-ups (inflow-outflow). It was necessary to throttle the inlet valves nearly to "closed" position to get a reasonable temperature rise.

Now a single line replaces the 7 to 10 original cooling hook-ups. This one line is connected in series, progressing from the coolest parts of the fans and turbine drives to the hottest—from main pedestal bearings through gear reducers, oil coolers and finally to the turbine's main bearings. Series hook-up meant a 60 per cent reduction in the amount of cooling water used.

But this conversion system could not work unless each of the tower systems was equipped with built-in chemical contaminant reclaimers. System No. 2B contains a typical decontaminator which feeds spent acids from various pickling processes to a sump and then into a series of three clarifiers (70, 90 and 115 feet in diameter). Acidic water enters the first Turbo mixer where lime is added. Overflow from this tank passes into a second and from there to a third. Part of the overflow from the third mixer is pumped back to the first for recirculation, and the surplus overflows into a 50 foot thickener from which sludge is pumped to a sludge bed. Neutralized water is discharged to a chlorinating basin in the sewage disposal plant and eventually is returned to the mill for further use.

Recovery of water from the various steel making processes goes even further at Kaiser Steel. Gas liberated in the coking process is passed through a by-products recovery plant, the moisture is condensed out and recovered. Although this moisture is unsuitable for industrial cooling without expensive treatment, it's collected in a sump and used for coke quenching.

AIR COOLING unit in a motor room is series-connected for re-use of water

Cost of Reclamation

Admittedly, Kaiser Steel has invested heavily in its water recirculating and reclaiming systems. But its plant management believes this investment a requisite for maximum water reusage efficiency. For example, in Kaiser's new tin plate mill, some $350,000 is being spent for a system designed to handle 60 gallons of reprocessed water per minute. Another 7,000 gallons per minute will be recirculated. Obviously, such relatively small quantities could be wasted for many years before costing $350,000. But the Kaiser people don't see it that way. In the long run, they say, the capital expenditure will be repaid by water savings and by greater plant efficiency.

Kaiser's chemical laboratory runs weekly check test to verify the spot tests of operators, who check results every three hours at each tower cooling system.

Remember that, from the first cooling tower which uses fresh make-up water, the water (even though frequently clarified) gradually reaches a point where it can be used only for such industrial processes as coke quenching. Typical water analyses run on various tower samples show that while water at No. 2B contained 460 ppm total solids, tower No. 1 contained 1,019 parts. Total solids count at tower No. 5 was 1,441 ppm. Fresh make-up water entered the system with solids varying between 34 and 205 ppm.

Table 1

Analyses of water in the Kaiser system (ppm)

	CO_2	HCO_3	Total Alk.	Cl	pH	SiO_2	Na	Fe	SO_4	Ca	Mg	Total Solids
Raw Water, June	12	128	140	9	8.20	10	0	TR	13	45	6.54	175
Treated Water	8	44	52	12	8.80	10	6	TR	12	15	3 27	34
Raw Water, August	0	165	165	16	8.10	30	11	TR	8	46	6.22	128
Treated Water	8	40	48	11	8.90	20	10	TR	8	8	3.71	52
Kaiser Well #1	0	152	152	16	7.70	20	0	TR	8	53	5.89	205
Kaiser Well #2	0	133	133	13	7.82	20	5	TR	8	42	6.11	164
Kaiser Well #2B	0	35	35	58	7.20	10	47	.4	176	66	6 44	460
#1 Tower	26	169	195	268	8.31	20	198	.2	134	66	14.41	1019
#5 Tower	50	273	322	412	8.32	20	334	.2	168	70	18.35	1441

Results Obtained

Kaiser Steel's waste disposal systems, which emphasize the reclaiming of chemically contaminated process waters, have allowed a major steel producer to build and expand in an area otherwise untenable from the standpoint of a dependable water supply.

Where other U.S. steel plants sometimes use and discard as many as 230 million gallons of water per day, the Kaiser plant uses but 2.5 million gallons of make-up water. Thus, in some cases, the plant's processed water is reused as often as 50 times before it finally evaporates.

Likely, there isn't another major installation in the United States with a similar water reuse record.

W&SW

Valves for Water Works Applications

Selection, Operation and Maintenance

by ROBERT C. KAUFFMAN, *Engr., Wiedeman & Singleton, Engineers, Atlanta, Georgia*

NOTHING can be more disheartening to a water works man than to be required to operate a faulty valving system. Even in the first water works, hundreds of years ago, the valving of water systems was a problem. Today, we are in a much better position to control these problems than were water works men twenty years ago.

The efforts of water works men in general, and those of farsighted manufacturers, have produced an imposing array of many types of valves which may be used for different purposes. It is no longer necessary nor desirable to use the same types of valves for all purposes, as was done twenty years ago.

It is impossible to describe and discuss all the different types of valves which can be used for different purposes. For that reason this discussion is confined to valves which are particularly related to control of water; the commonly known valves by which the flow of water may be started, stopped or regulated by a movable part which opens, shuts or partially obstructs one port or passageway.

Valves for Specific Purposes

In the category of such commonly known valves are: sluice gates, foot valves, gate valves, check valves, cone or plug valves and butterfly valves. Each type of valve has merit when properly selected for the function for which it is to be used.

A conventional water works system is composed of several very definite parts; each presents valving problems which are not necessarily the same as for the other parts. Raw water intakes may be of the river type with attendant sand and trash troubles. Raw water pumping stations may take water from such intakes or may be composed of deep well pumping units. Raw water supply lines may be short or long. Filtration plants may be utilized for the treatment of raw turbid creek or river water; or for treatment of water from deep wells. High service pumping stations, water distribution systems and elevated storage facilities will, in general, be similar regardless of the source of raw water.

The following discussion approaches these points in a sequence from raw water supply through treatment to distribution.

> *"Nothing can be more disheartening to a water works man than to be required to operate a faulty valving system."*

Sluice Gates

Consider a raw water intake of the river type, such intakes are generally constructed of reinforced concrete with large inlet openings to reduce, as much as possible, the amount of sand and trash which may be drawn into the openings. Frequently it is desired to shut off the flow of water through these openings for cleaning out suction pits or otherwise. Due to the fact that these openings are generally of large size, sluice gates will serve these purposes very well.

In selecting such sluice gates, it is desirable that the gates should be of rugged construction. A cast-iron thimble may be placed in the concrete work to which the gate frame can be bolted. The gate and frame may be of cast iron with bronze-mounted contact surfaces; and with bronze side wedges and shoes to insure tight closure. If the gate is to be of the self-contained type with the operating gearing under water, the stem should be of solid bronze. If the operating gearing is above water, the stem may be of cold rolled steel. In either case the gate should be operated by an operating stand above. If the gate is comparatively small or is to be operated infrequently, with long intervals of time between operations, then the operating stand should be either of the handwheel type for the smaller gates or of the geared crank type for large gates. If the gate is large and will be frequently operated, such operation should be by electric motor or hydraulic cylinder instead of the hand-operated wheel or crank stands.

Operation of sluice gates, of any real size, by handwheel or crank, require considerable energy on the part of the operator. It is assumed, of course, that the gear ratio is such that not more than 25 pounds of pull is required to open the gate regardless of the gate size. The larger the gate, the more time it will require to be opened.

Maintenance of a sluice gate of this type is simple. The parts under water rarely require attention. The handwheel or crank stands require lubrication approximately twice a year. Electric motor or hydraulic cylinder operated stands require no more than the usual attention given to any other standard electric or hydraulic equipment.

Foot Valves

Foot valves should rarely, if ever, be used for pump suction pipes taking water from a creek or river; with the expectation that the foot valve will function to eliminate a separate priming system. The difficulty is that while a water works man is relying on the foot valve to insure positive priming of his pump, the foot valve may fail in this respect, due to trash which can get caught on the seat causing the foot valve to fail so far as its intended function was concerned. Foot valves have been used for such purposes, however, with clear water pumping equipment, and have performed with satisfactory results.

Pump Valves

Selection of valves for a raw water pumping station should receive about the same considerations to be given selection of valves for a high service pumping station.

A typical pump installation, one which is connected to a common suction header with other pumps and discharging into a common discharge system, requires valving to perform three basic functions: The first is a suction shut-off valve to enable the operator to isolate the pump from the common suction header. The second is a shut-off valve for the pump dis-

Mr. Kaufman's paper was presented before the 21st Annual Georgia Water and Sewage School at Ga. Inst. Tech., and is here printed by permission.

"Foot valves should rarely, if ever, be used for pump suction pipes taking water from a creek or river."

charge. The third is a check valve between the discharge shut-off valve and the pump discharge nozzle to provide emergency shut-off protection in case the motor is "knocked" off by power failure.

A typical pump installation may be divided into two classes: "Manual Operation" and "Semi-Automatic Operation."

For *manual operation* it is customary to leave the suction shut-off valve open at all times. The pump is started with the discharge shut-off valve closed; slowly open the valve after the motor is up to speed. The pump is stopped by slowly closing the discharge shut-off valve; after which the pump motor is stopped.

It can readily be seen that the discharge shut-off valve of any line pump will have more operation and tendency to wear than any other single valve in the water works system; and should, therefore, be of the best and most rugged design. By the same token the check valve, which must open and close each time the pump is shut down and must "float" in the stream all of the time the pump is running, must be equally dependable and be rugged enough to withstand the tremendous shocks which accompany emergency shutdowns due to power failures.

The suction shut-off valve may be a standard, flanged gate valve, AWWA type; except it should have a handwheel with outside stem and yoke in order that the operator can observe its position; open or closed, at a glance.

The discharge shut-off valve may be a standard, flanged gate valve, AWWA type; except it shall also have a handwheel with outside stem and yoke and should be of the square bottom type.

The check valve should be at least heavy enough to operate at the same pressures and under the same conditions as the discharge shut-off valve; and should be iron body, bronze mounted with flanged ends. The valve should be of a type such as will minimize slam as much as possible.

For the small pumping stations, manual operation of the suction and discharge shut-off valves will not be any problem. The average man will be able to open and close the suction and discharge valves in the 6- to 8-in. sizes and even up to 10-in. size without undue strain; depending upon the operating pressures of the individual pumping station. As the valves begin to wear, the amount of energy required to open and close, of course, becomes greater. Also, as the valve size increases, more time is required for opening and closing to a point which may be considered undesirable. Therefore, above a 10-in. discharge shut-off valve, semi-automatic operation should be considered.

Semi-automatic operation calls for valving to perform the same three basic functions as for manual operation; except that two of these functions are semi-automatic.

For semi-automatic operation, it is also customary to leave the suction shut-off valve open at all times; therefore, the suction valve may be of the same type as used for manual operation. Thus, two functions are performed by semi-automatic valving; namely, discharge shut-off valving and check valving to provide emergency shut-off protection in case the motor is "knocked" off by power failure.

There are several ways by which semi-automatic discharge shut-off and check can be provided. One of the best is by the use of a cone or plug type valve; with electrical and hydraulic accessories to permit semi-automatic operation as combination shut-off and check valve, with solenoid controls for normal slow opening and slow closing and for fast emergency closing.

In operation, normal opening is accomplished by first bringing the motor up to speed with the valve closed, after which the cone valve is opened by means of electric "open" push button. Normal closing is accomplished by means of electric "close" push button. Upon the cone valve reaching the approximate point of closure, a limit switch built in the valve can be made to actuate the main power contactor to shut down the motor. In case of incoming power failure or failure of power to motor, the valve can be made to close automatically and remain closed until again opened by means of electric "open" push button. These features provide for two of the three basic functions; that of start-stop and check, with little effort on the part of the operator regardless of the size of the valve.

In addition to these start-stop and check features, such a valve also can be made to provide protection to the pump in case of water supply line breakage. By means of a pressure switch connected to the inlet side of the valve, it can be made to close automatically in the event of loss of pressure due to line breakage. This pressure switch will also function to prevent normal opening of the valve in case the pump does not develop proper discharge pressure.

The single word "automatic," as used above, should be used with great care, since anything that moves is subject to failure of operation at some time. For this reason it is best to equip any automatic cone check valve with auxiliary control to allow manual opening or closing by means of a handwheel to operate the hydraulic control system irrespective of the electrical controls.

In most cases, there will be sufficient water pressure available in a pumping station to allow operation of a hydraulic control system. Consideration must be given, however, to the type of water available for such use. If the water carries silt or other impurities, it will not be satisfactory for hydraulic control. In such cases, it is necessary to install an oil pressure system. The oil system, in general, will consist of a pressure tank, pump, and air compressor arranged to maintain a sufficient amount of oil under high pressure for operation of the hydraulic control system.

In the case of high service pumping stations, most of which are operated in conjunction with a water filtration plant, the use of filtered water will allow satisfactory operation of a hydraulic control system.

Maintenance of a semi-automatic installation of the cone check valve type requires the usual amount of care given any electrical and hydraulic control system. The main rotating element or cone plug will require practically no attention except for occasional lubrication. Operation of a hydraulic cylinder is actuated by relay and pilot valves and may be subject to clogging and corrosion; in which case these units must be

"The word 'automatic' should be used with great care, since anything that moves is subject to failure of operation at some time."

cleaned. When an oil system is used for hydraulic control the tendency toward clogging or corrosion is minimized. Where water is used the tendency to clog or corrode exists to a greater degree and the actuating units must, therefore, be cleaned more frequently.

Valving for a deep well pumping installation can be said to be subject to the same general considerations as for a raw water or high service pumping station; insofar as discharge shut-off and check are concerned, even to the extent of selection of the "manual" or "semi-automatic" type of operation.

Filter Plant Valving

Selection of valves for a water filtration plant receive the same consideration regardless of the source of supply, e.g. river, lake or deep well water. A conventional water filtration plant is made up, in general, of several separate but related parts. Each contributes to the process; chemical treatment, coagulation, sedimentation, filtration and high service pumping.

From the point of chemical treatment through the process of coagulation and sedimentation, it is general practice to transport the treated, coagulated or settled water through a system of pipes or flumes of relatively large area, in order to hold velocities of flow and losses of head to a minimum.

For the smaller transporting pipes (up to and including a range of 16- to 20-in. in diameter) it is practicable to use low pressure gate valves for control and shut-off. The valves are required to operate against pressures seldom exceeding 15 psi. For this reason, by-passes should not be required; otherwise the valves should be of AWWA type. If installed in a vertical position, spur gearing should not be necessary. If installed in a horizontal position, the valves should be equipped with bevel gearing, grease case, tracks, rollers and scrapers. Operation of these valves will not require a great amount of energy, due to the low pressures against which they will be operated; but the larger the valve the more time will be required to open and close.

For the larger transporting pipes, including and beyond a range of 16 to 20 in. in diameter, it is practicable to consider the use of butterfly valves for control and shut-off. Use of butterfly valves for water works is relatively new and will most likely be used to a greater extent than at present, particularly for control and shut-off service in large diameter piping systems of low operating pressures.

"Butterfly valves for water works . . . . will most likely be used to a greater extent than at present . . . ."

The operating mechanism of a butterfly valve is simple. A standard valve is essentially composed of a cast iron body with an inside vane attached to a shaft. The cast iron body has flanged ends and resembles a cast iron spool piece of from 8 to 12 in. long. The vane is, of course, round. When the valve is in the open position, the vane is turned edgewise to the flow. The vane is moved to open or close the valve by a geared mechanism attached to the shaft outside the body.

Due to the pressure being practically equal at the top and bottom of the vane, the valve can be opened or closed with ease regardless of size or pressure. Generally, the valve can be opened or closed, with very few turns from (10 to 15 for average sizes). Resistance to flow in the open position is very low. The operating mechanism can be adapted to any of the standard operations; (manual, electric, hydraulic or air), but since a small amount of energy is required for opening or closing, these valves are usually operated manually, unless the installation is to be one of automatic or remote control.

Unfortunately, there are no standard specifications for furnishing butterfly valves for water works service, such as has been formulated by AWWA for gate valves. For this reason butterfly valves should be obtained only from manufacturers who have specialized in furnishing valves for water works service. The most popular type of valve for low pressure service is what is known to be the "50-pound type" for hydraulic service.

Where treated, coagulated or settled water is transported through a system of flumes of relatively large area, within which control and shut-off may be required and where velocities of flow and losses of head must be held to a minimum, it is often desirable to use sluice gates. Such flumes will in most cases be constructed of concrete. Selection, operation and maintenance for sluice gates for this service will, therefore, be subject to very nearly the same considerations as has been previously discussed for raw water intakes.

Filter operation requires valving to perform at least five functions: Influent control, effluent control, wash, drain, and re-wash. Operation of an average filtration plant requires that filters be washed after a period of 100 hours of service or less, which means that all valves must be operated at least once every four days, a total of 91 times per year. In some plants washing operations are more frequent. Aside from pump discharge valves, no other valves in the plant are required to stand such service. For this reason, selection of filter operating valves should also receive careful consideration.

There are two methods of operation for filter valves which are most generally used; namely, manual and hydraulic. A conventional filter design places the operating valves in a pipe gallery below the operating floor. For *manual operation,* the valves are equipped with extension stems to handwheel operating stands located on the operating floor above. For *hydraulic operation,* the valves are equipped with hydraulic cylinders and connected by means of small piping to levers mounted on an operating table on floor above.

For filters of 500,000 gpd capacity and less, it is customary to consider manual operation. For filters of 500,000 gpd capacity and more it is customary to consider hydraulic operation. Actually 500,000 gpd capacity is the "break-point" when it comes to consideration of manual vs. hydraulic operation.

For either manual or hydraulic operation, it is best to design the filter piping system so that filter valves can be installed in a vertical position. Valves for influent, effluent, drain and re-wash may be of AWWA type. The wash valve may be of AWWA type, except that it should be square bottom. All hydraulic valves should have tail rods extending through the cylinder heads with eyebolts. Wash valves equipped with hydraulic cylinders should be provided with an adjustable device to restrict full opening; to limit

A perfect valving system is one within which any distribution main in any block can be isolated without having any appreciable effect on the operation of the system."

the rate of wash rise for any one filter or filters operating from a common main wash header.

Operating station pressures for an average water works will run from 75 to 150 psi. Operation of hydraulic cylinders at pressures greater than 50 psi causes increased wear, which requires more maintenance. Hydraulic cylinders, therefore should be operated at pressures less than 50 psi. It, therefore, becomes desirable to provide a pressure-reducing valve, off the station system, and run separate header and supply lines for operation of hydraulic cylinders.

It is essential, for the protection of filter beds, that all hydraulic valves be prevented from fast opening and closing. Needle valves should be installed in the small hydraulic piping systems by which the rates of opening and closing can be readily adjusted to suit the desired operating conditions.

Supply and Distribution System Valving

The first municipal water works systems consisted only of supply and distribution. In early plants, a source of supply was established at some higher elevation than that of the points of use and the water simply flowed by gravity into the distribution system. In the early days of the Roman empire distribution systems consisted of aqueducts and open flumes. It was not until pipes came into use that valving of distribution systems came to be a significant problem.

Development of valving arrangements for supply mains, feeder mains and distribution mains has progressed to the extent that such arrangements have become fairly well standardized over the last 50 years or so. Types of valves available have steadily improved so that we are now in position to make better selections for varied conditions of service as never before. No longer is it proper to simply order a "gate valve" without giving some thought to conditions of service.

Supply Main Valving

Valving for raw water and high service supply mains may be considered to be similar for average service conditions. Such mains are usually of larger diameter than feeder mains and distribution systems; and may, therefore, be considered to require special attention as to selection of valves. Operating pressures are generally high, and such valves are not operated often.

Most supply mains will be 16 to 30 in. in diameter and larger; and due to the severe service to which the valves will be subjected, it is best that all such valves have by-passes and gearing. By-passes allow equalization of pressure on each side of the gates to facilitate operation and to eliminate the tremendous wear which occurs when any large gate valve is operated against full unbalanced pressure. If valves could always be operated under conditions of balanced pressures, gearing would not be necessary. Unfortunately, there are emergencies where the valves must be operated against full unbalanced pressures; for this reason gearing should be provided to allow relatively easy opening and closing.

"All distribution systems should be accurately mapped and locations of the valves carefully recorded for ready use when needed."

By-passes for valves of various sizes have been standardized by specifications of the AWWA, and it is seldom necessary to deviate from these standards.

Gearing has also been standardized as to the energy requirements for opening and closing against unbalanced normal operating pressures up to 150 psi. When selecting such a valve, however, it is necessary to specify the type gearing and desired arrangement.

Two types of gearing are available: namely, spur gearing and bevel gearing. Spur gearing is used when the valve is to be installed in a vertical position. Bevel gearing is used when the valve is to be installed in a horizontal position.

The gearing should be enclosed in a grease case of which there are two types, integral and extended. If the valve is to be laid in the ground, the integral grease case will be best. If the valve is to be laid with manhole access to gearing, the extended grease case will be best.

The disadvantage of the integral type of grease case is that in order to service the packing gland the case cover must be removed. It is, therefore, obvious that the case should be designed to withstand the operating line pressure which could develop as the result of a leaking stuffing box.

The advantage of the extended type of grease case is that the case is made to clear the packing gland; allowing servicing without having to go into the case.

Valves may be for vertical or horizontal installation, but, the larger valves are of such dimensions that it will be better to install them horizontally rather than lay the pipe line deep enough to allow surface clearance for the top of the valve. In the case of valves installed horizontally, they should be equipped with tracks, rollers and scrapers to allow opening and closing of the gates, relatively free of wear and tear.

Feeder Main Valving

Selections of valves for feeder mains of 16 in. dia. and larger are subject to the same considerations as valves for supply mains. Valves for feeder mains of 14 in. dia. and smaller are subject to the same considerations as for valving for distribution systems.

Distribution Valving

Never has there been a distribution system with too many valves. A perfect valving system is one within which any distribution main in any block can be isolated without having any appreciable effect on the operation of the system. Sizes of pipe in the average distribution system will run from 12 in. dia. down to 4 in. dia. Such sizes, with customary depths of cover of from 3 to 4 ft., in most cases will allow selection of valves for vertical installation. By-passes are generally not required and the valves are so designed that gearing is seldom necessary. Most manufacturers are well equipped to furnish these sizes of valves in accordance with AWWA standards, with hub ends, flanged ends or mechanical jointing as may be required.

In recent years a new type of jointing has been developed by the pipe manufacturers, called "Manufacturers Standardized Mechanical Jointing." This type of joint is similar to the time honored bell and spigot joint except that the jointing consists of a premolded rubber ring compressed into the joint socket by means of a bolted follower gland. This type of joint is also available for valves, if

"A real way to insure that the distribution valving system is equal to the service you expect from it is to have a program whereby each valve is operated and checked at least once a year."

so specified. The joint is "bottle tight" and a willing workman can be quickly trained to make such a joint with no tools other than a ratchet wrench.

High on the trouble list in distribution systems, are the problems involved in making large diameter cut-ins to existing water mains. In the past it has been customary to shut off the water, cut out a section of the main, set in a tee and attach a valve, all of which has become a costly and laborious operation, to say nothing of the howls from the water customers.

Any water works man who has any considerable number of valved cut-ins to make or who has to make a valved cut-in at any hazardous point should investigate the possibilities for using mechanical tapping sleeves and valves. Such cut-ins are made by fitting a bolted split sleeve onto the main with flanged tee joint and valve. A tapping machine is then bolted onto the end of the valve, cutting through the pipe wall, after which the valve is closed and the machine removed. At no time during the operation is it necessary to shut off the flow of water. Many persons have the idea that such cut-ins are too costly, which partially accounts for limited use in the past, but if the costs of materials and labor for the "dry" type of cut-in are compared to the "wet" type, it appears that the total cost is about the same in each case.

Faulty operation of gate valves can sometimes be traced to errors in manufacture, often to damage in shipment and to careless installation. Three common causes of faulty operation are damaged stems, scored seat and gate rings, and fouled wedging mechanisms. All reputable manufacturers of valves have assembly line inspection systems maintained to produce valves as free from defects as is possible, but, it is good practice to "operate" and inspect the workmanship for all valves at "ditch-side" prior to installation. If any valve is found to be faulty, the manufacturer will most certainly not want it to be used, and neither will the water works man who will have to depend on it for emergency shut-off.

Equally discouraging is a valving system of which there are no records of the valve locations. Many water works men are operating systems of which many of the valve boxes are paved over or otherwise lost for emergency purposes. All distribution systems should be accurately mapped and locations of the valves carefully recorded for ready use when needed. Inability to find a valve in case of emergency can mean disaster. The files of insurance companies and fire departments contain many records of failure to save life and property due to faulty valving systems or inability to find valves quickly.

To insure that the distribution valving system is equal to the service you expect from it, have a program whereby each valve is operated and checked at least once a year. If a valve is found to be faulty, it is much better to repair it at leisure than to suffer an emergency which cannot be met.

Besselievre to Head New Industrial Wastes Div. of Kaighin & Hughes, Inc.

Kaighin & Hughes, Inc., piping and mechanical contractors of Toledo, Ohio, have organized an Industrial Wastes Division with Edmund B. Besselievre as its manager. With organization of the new division, the firm is equipped to provide all services, including design, engineering and contracting to solve waste materials problems.

Formerly chief sanitary engineer of The International Division of The Dorr Company, Stamford, Conn., Mr. Besselievre is a recognized authority on treatment of industrial wastes and has handled sanitary engineering projects in 63 countries of the world over a period of 30 years. Author of the book, "Industrial Waste Treatment," published in 1952, he has written more than 75 technical articles on that subject and allied phases of sanitary engineering.

A member of the American Society of Civil Engineers and other technical associations and a registered professional engineer, Mr. Besselievre has served with prominent sanitary missions to other countries. He is a founder member of a number of leading technical associations in the sanitary engineering field.

Kaighin & Hughes in its 20 years of operation has completed contracts in the United States totaling more than $175,000,000.

Chester Drake Retires from Pittsburgh Water Plant

Dr. Chester F. Drake, city filtration plant superintendent who came to Pittsburgh in 1908, resigned as of August 1. He and his wife will move to Virginia.

Dr. Drake was graduated in 1898 from Massachusetts Institute of Technology. He was made honorary Doctor of Science by Duquesne University in 1923.

Industrial Water System Designed for Defense

An industrial water supply network custom-engineered for defense purposes has just been shipped to the Badger Ordnance Works, Baraboo, Wisconsin, by the Automatic Control Company, St. Paul, Minnesota. The water is used in the treatment of industrial slurry and industrial wastes. Five completely-independent units were provided. Each unit will continue operating even though an identical unit is destroyed. The units are located underground for additional defense.

Water is pumped from a cold well to cool machinery in an explosive area. Five units of two pumps each operate in this capacity. They are alternated at intervals to equalize wear and prolong life by Autocon equipment. The water, heated in this process, returns to a storage sump. It is then pumped from the sump to a cooling tower. From the tower it is returned to the cold well to be reused. Alarms are placed in key areas to warn of pump, power or water supply failure.

W. W. Aultman Joins Alvord, Burdick and Howson

W. W. Aultman has resigned from his position as Assistant Director, Department of Water and Sewers, Miami, Fla., to join the Chicago firm of Alvord, Burdick and Howson, Consulting Engineers.

Until coming to Miami in 1951, Mr. Aultman was Water Purification Engineer with The Metropolitan Water District of Southern California.

AUBURN'S Sewage Treatment Works

Grit Handling Made Easy

Auburn, N. Y., uses a unique tubular conveyor, known for its performance record in industry

by JAMES M. SYMONS* (B.CE.),
Larchmont, N. Y.

THE writer has come upon a new idea in grit handling at sewage treatment works. Auburn, N. Y., is using a positive displacement tubular conveyor for the transportation of grit. This system of conveyors is designed to offer efficient, trouble free conveyance of solids through any plane or any angle, to any convenient point of disposal in the plant.

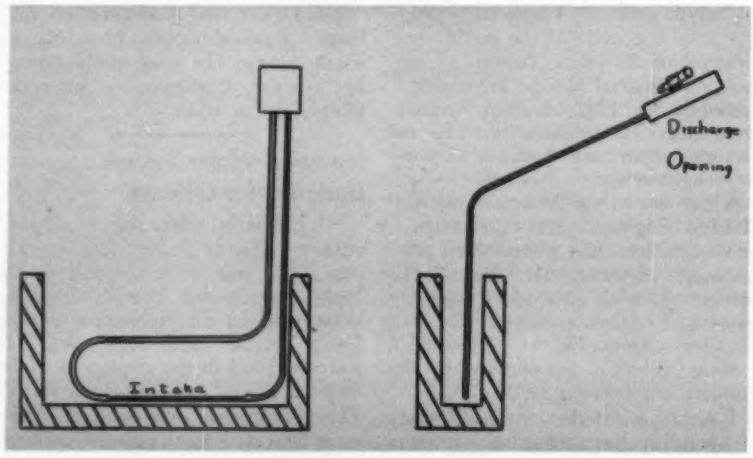
Hapman Tubular Conveyors, new to the sanitation field, are in use by many industries for the transportation of flowable particulate material; materials such as abrasive dusts, granular materials, powered materials, sludges, and bulk chemicals. Now, grit from sewage has been added to the list of materials successfully handled by these tubular conveyors.

Location of Installation

Auburn, N. Y., where this new idea in grit handling has been proven, is a community of 40,000 plus. The sewage treatment works has a capacity of 7.5 mgd, according to the Chief Operator, James T. Lynch. The plant handles sewage from Auburn, Auburn State Prison and the Town of Owasco.

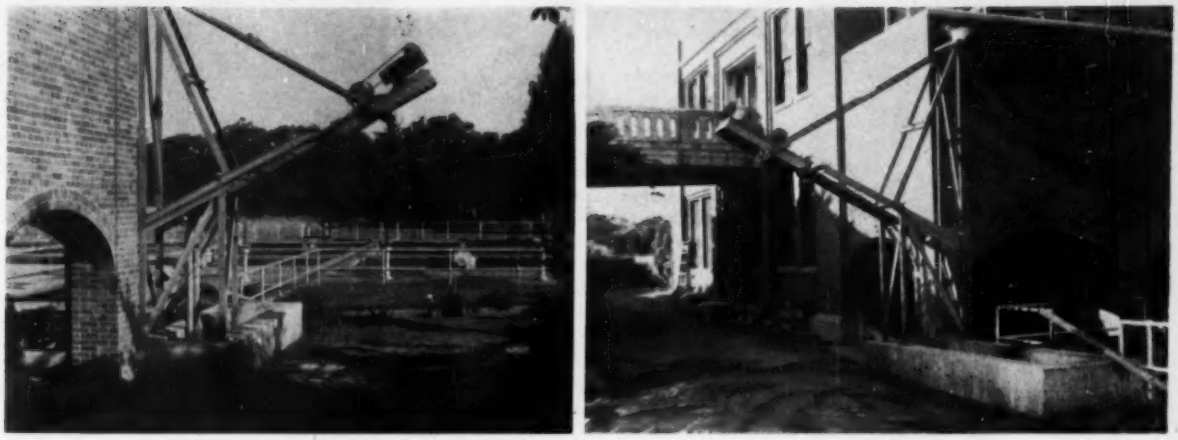
The effluent is discharged into Owasco Outlet. The average flow at the treatment work is about 6 mgd, with maximum flows of more than 9 mgd having been recorded.

There is a possibility that in the near future, waste from a nearby county park may be added to the system. Maximum attendance at the park is upwards to 10,000 on the weekends, but since many of the 10,000 would be



SKETCH of tubular conveyor showing elevation and end views

* Graduate Student in Sanitary Engineering, Mass. Inst. of Technology.



HAPMAN Tubular Conveyor—fore and aft views, showing motor drive

From the upper end cleansed grit drops into truck body.

persons from the Auburn area the additional load on the facilities would be less than 10,000 total. The sewer system being of the combined type produces large quantities of grit and plant overloading in rainy or thawing weather. Addition of the park load probably will further aggravate the overloading.

When the plant was first put into operation it utilized chemical flocculation, primary sedimentation, and chlorination. Sludge was vacuum filtered and the sludge cake incinerated. As soon as the plant was put into operation a serious grit problem developed. Normal domestic sewage contains from two to three cubic feet of grit per million gallons, grit that will be removed in a treatment plant whether or not grit removal facilities are provided. This condition is aggravated in a combined sewer system which brings the grit from the streets to the plant.

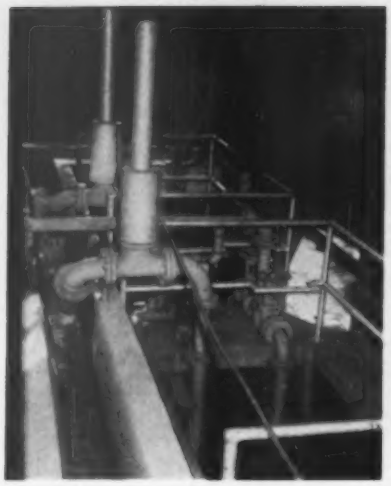
Since no grit removal facilities were included in the Auburn plant design, most of the grit settled out in the flocculating basin. This caused a real maintenance problem. Although the effluent produced was quite acceptable, the wear and tear on the mechanical flocculating equipment was causing frequent breakdowns and shutdowns. Grit was also a problem in the sedimentation basins and in the sludge incinerator. Because of grit wear, maintenance was a problem throughout the plant.

In 1953, in an effort to remedy this situation, the flocculating basins were eliminated and converted into grit chambers. The consulting engineers, who suggested the substitution of grit removal for the flocculating basins, had become impressed with the potential advantages of the tubular type conveyor for handling sewage grit and incorporated a Hapman Tubular Conveyor in the grit chamber design. The grit chambers also utilized the Chicago Pump Co. "Aer-Degritter" with jet pumps to cleanse and lift the grit from the grit chambers. Grit is discharged from each of four chambers into a single open channel. The channel slopes to a hopper through which the Hapman Tubular Conveyor passes, the open or receiving part of the conveyor tube being at the bottom of the hopper—see sketch.

The Tubular Conveyor

The Hapman Tubular Conveyor consists of a tube ranging in size from three inches to twelve inches for different installations, through which an endless chain moves. Between every link in the chain, a close fitting disk is attached. These disks are only slightly smaller than the tube. A motor driven sprocket at one end of the installation engages the chain and pulls the disks or flights through the tube. An open section of the tube admits the material, while another open section allows for discharge. The flights

AIR PUMPS that supply air to the "Aer-Degritters" which deliver cleansed grit to the tubular conveyor



GRIT DISCHARGE at Auburn Plant
Illustrated are two of four air-lifts flowing to tubular conveyor hopper

can be specified as either synthetic rubber bonded between steel plates, cast iron, stainless steel, bronze, magnesium, plastics, or fibre. These conveyors will move materials at rates up to 100 feet per minute and for distances up to 300 feet in a single run. Since the flights are linked by a chain they are completely flexible and therefore will follow the tube through any angle or any plane. The pins that link the chain are protected by compressed Neoprene washers so that the conveyed materials cannot reach the pin and cause wear. This feature practically eliminates maintenance.

These manifold advantages add up to a good solution to one of the most universal problems in sewage treatment plant operation, that of grit removal and handling. Other grit removal systems have inherent problems and disadvantages. Dewatering and hand removal is obviously unsatisfactory; the continuous scraper system combined with belts or continuous buckets for transportation is cumbersome and subject to maintenance problems. The Hapman Conveyor system collects and transports all in one operation, it has low maintenance costs and is very compact.

At Auburn, the Hapman Tubular Conveyor takes the grit around a 90° corner and through a 45° bend from the horizontal. It elevates the grit to a point high enough for a receiving truck to be driven under the discharge opening. A three inch tube is used and the chain speed is five feet per minute. At this velocity, with the conveyor running up hill, the grit is dewatered, before discharge.

Operating Problems at Auburn

Unfortunately, the change in treatment plant design substituting grit removal for flocculation, did not prove to be a cure-all. Now, when the plant is overloaded, the velocities through the grit chamber are higher than recommended for efficient operation. The detention time in the sedimentation basins (two hours at 5 mgd) is correspondingly reduced. At times of spring thaws, when cinders from the streets arrive at the plant, the velocity is so great, due to the overload, that the grit carries past the grit chambers and settles out in the sedimentation basins. As often as twice during the spring, the sedimentation tanks must be dewatered and grit removed by hand.

Other problems also plague Mr. Lynch: The bottoms of the grit chambers do not slope sufficiently to the inlet of the jet pumps; therefore all of the grit that does settle out is not removed by the pumps. Often, high pressure hoses are directed into the chambers to aid the grit on its way into the pump suction. When this is done the grit comes up in the pumps in great quantities, more than the heaviest normal rate.

In spite of these removal aids the grit chambers must be dewatered periodically and some grit removed with shovel and bucket. One of the four chambers in use from March to August had 109 pails of grit removed from the bottom when the tank was dewatered. Mr. Lynch also reports that a cloth will sometimes clog the jet pump causing an interruption of grit removal.

Auburn's tubular conveyor does not appear to be one of Mr. Lynch's problems. It has successfully handled both small and excess grit loads. During the one year of operation, Mr. Lynch reports satisfactory performance. The only difficulty has been in freezing. The chain speed in this installation is so slow, five feet per minute, that the wet chain freezes as it becomes exposed to the zero weather that is common during the winter in Auburn, N. Y. This condition is being remedied by the addition of heating coils wrapped around the exposed tube. Other than this minor problem, maintenance on the conveyor has been nil. The installation easily removes the 20 to 30 cubic feet of grit usually collected each twenty-four hours; it can remove much more when the occasion arises.

Due to plant overloading and other problems, the quality of the effluent from the Auburn plant has declined

DISCHARGE END of Hapman Conveyor
Note drive sprocket and the close-fitting discs which move through the tube

in recent years, although the B.O.D. removal is still 50 per cent and the suspended solids reduction is from 30 to 60 per cent, depending on the flow. In an effort to avoid overloading the plant Mr. Lynch by-passed some of the influent during periods of large flow. Dilution in the Owasco Outlet is so small (zero at one time in Sept. 1953) that both odor and hydrogen sulfide gas problems downstream forced him to abandon the by-passing of even storm flow sewage.

Comments

It is this writer's opinion, formed during plant visits, that the Hapman Tubular Conveyor for the removal and transportation of grit appears to offer a ready solution to a problem that is inherent in sewage treatment. As might be expected with a new application, the actual installation at the Auburn plant is a little cumbersome. Pumping the grit into an open channel and then into the Hapman Tubular Conveyor hopper seems inefficient. A better scheme might be to have a Hapman Conveyor hopper in the bottom of each grit chamber. It is understood that such an arrangement has been proposed for the Village Creek Sewage Treatment Plant in Jefferson County, Ala. In this installation there will be four Chicago Pump Co. "Aer-Degritters" in parallel. Each grit chamber is to be equipped with a six inch Hapman Tubular Conveyor of 1.5 cfm capacity in the bottom. Each of these elevating conveyors will discharge into a six inch transferring conveyor with a capacity of six cubic feet per minute. This latter conveyor will transport the grit to the disposal point.

Controlled Humus Production by Separate Sludge Digestion and Drying

Part I—Principles of Manufacture

by LEONARD L. LANGFORD

Mr. Langford is Eastern Sales Manager, Pacific Flush Tank Co., Port Chester, N. Y. In three comprehensive articles, he evaluates the digestion and drying of sewage sludge in terms of a manufacturing process. His paper was presented at the seventh annual meeting of the Virginia Industrial Wastes & Sewage Works Assn.

EVERY separate sludge digestion facility is to a greater or lesser degree efficiently producing tons of material, the fertilizing potentialities of which have been largely ignored. Bearing in mind the value of the end-product and the large investment in plant and structures, why not consider the reduction of sewage-waste solids as a (biological) manufacturing process, rather than as the most difficult part of sewage treatment? Buswell, as a result of bacteriological research, feels that we can control the process of sludge digestion by methods similar to those of other fermentation industries.[5] Let us therefore consider our subject from the point of view of increasing the efficiency of process reaction, with respect to the degradation of organic waste solids.

Too frequently, sludge digestion is thought of either as a mechanical or a chemical process. While the mechanical aspect of digestion tank and control center design is of importance, and while chemicals also occasionally play a leading role, these considerations must be subordinate to controlled biological activity. We are completely dependent on the later for the manufacture of an acceptable end-product having value as humus and as a fertilizer base.

According to Buswell, "Anaerobic fermentation has long been recognized as the cheapest method of removing organic matter, carbon and hydrogen from sewage or waste liquors, where conditions are suitable for its application."[6] Figures on milk wastes, from the Illinois State Water Survey, indicate that the cost per pound of carbon and hydrogen removed by sludge digestion is one-twentieth the cost in-

INTRODUCTION

"Three hundred years ago approximately half of the total area of the United States was covered with forests. Most of our rivers ran clear. Salmon were so abundant in eastern rivers that indentured servants included in their articles a limitation on the numbers of times a week they should have to eat this fish."[1]

In the museum and old church at Jamestown, Virginia, there are tablets in memory of John Rolfe, and a tribute to his skill in making possible the drying and commercial exploitation of tobacco. A National Park Service sign states that his technique affected the economy of Virginia for a hundred and fifty years. William Vogt in his exceptionally valuable book, *Road to Survival*, comments that "this is a major piece of understatement." In 1799, largely as a result of intensive tobacco cultivation, Albermarle County was called "a scene of desolation that baffles description—farm after farm . . . worn out, washed and gullied, so that scarcely an acre could be found in a place fit for cultivation,"[2] That extraordinary leader of the Confederacy, Edmund Ruffin, in the years before the Civil War, set about reviewing southern agriculture through fertilization and erosion control. Yet even today, more than three hundred years after John Rolfe's time, much of Albemarle County and the surrounding region is still fit only for low grade, second growth forest.

American civilization, founded on 9″ of topsoil, has now lost one-third of this soil. We are losing every day, as the result of erosion, the equivalent of two hundred 40-acre farms. During the past one hundred years, the Potomac River has carried more than half a billion tons of soil past Washington. Since early colonial days, erosion has removed from one-fourth to three-fourths of the best part of the crop-producing topsoil from more than five million acres of the complete Potomac River drainage basin. Small wonder that the deep harbor into which came oceangoing ships from the seven seas has filled with silt. The Lincoln Memorial, as well as other sections of Washington, now stand where not too long ago there was a busy port.

The consequences of insufficient ground cover of the right type—i.e., topsoil—are reflected in another problem "that should worry a good many Americans . . . our underground waters. Throughout much of the United States the water table is falling."[3] In the Baltimore area, for example, presumably as a correlative of the erosion and siltation just referred to, the water table has dropped 148 feet in thirty-two years.

With the need for topsoil so pressing, we cannot as a nation afford to continue to throw away the valuable organic humus of digested sludge. Sewage-waste facilities for the entire population of Virginia, for example, could provide sufficient digested sludge to cover over three hundred acres annually to a depth of one inch. While it is true that "a single inch of fertile topsoil is of precious little use to the farmer,"[4] organic humus properly utilized can help to counteract the losses caused by erosion, and can thus represent one of our country's greatest assets.

PROPORTION of volatile and fixed solids in raw sewage and settled sludge.

curred in treatment by aerobic processes.[7]

From observations made in recent years, I am of the opinion that the major problems facing those responsible for the processing of waste organic solids are:

1. Lack of adequate process facilities;
2. Interfering raw materials; and
3. Inadequate funds for operation and maintenance.

While no one is wise enough to anticipate or solve *all* of the multiplicity of organic reduction problems, we can endeavor to approach our problems analytically. It is not sufficient, I think, to repeat that sludge to be readily digested should be fresh; that it should be added to the digester frequently; that it must be kept submerged at a prescribed optimum temperature; that withdrawal of digested material should be frequent and in small increments. An understanding of the theoretical fundamentals, and the manner of applying them practically, is very necessary.

Theory of Digestion

Since sludge is derived directly from sewage-waste solids, it might be of interest to consider a graphic illustration of the physical condition of the principal solid constituents of a medium strength sewage, as in the accompanying diagram.[8] Only from forty to sixty per cent of the settleable suspended solids normally reach the digestion tank, in a primary treatment plant, and of them only the volatile settleable suspended solids are of particular concern to us.

The process of decomposition of raw organic matter to humus involves microbial and chemical action. The former process is biological and includes action of bacteria, fungi, yeasts, actinomycetes, protozoa, enzymes, etc. The latter comprises hydrolysis (a chemical reaction produced by decomposition of a compound in which its elements take up water) oxidation and reduction (the separation of an element from other elements combined with it).

Digestion is dependent upon biological action of microorganisms. Sewage-waste sludges normally contain and support the growth of bacteria and protozoa. These organisms utilize the organic matter as food supply for their growth and energy. Resulting from their metabolism, there are produced the intermediate products of methane gas and sludge liquor, and the end-product of an innocuous, amorphous, partly colloidal substance, properly referred to as "humus," commonly called "digested sludge."

The mechanism of anaerobic digestion is affected by toxins as well as by stimulants. The rate of digestion is influenced by environmental factors such as temperature, reaction (pH), and the proximity of proper organisms to organic matter to be reduced, as well as by the chemical composition of the solids.

In general, raw sludge is composed of organic constituents such as sugars, starches, cellulose and lignins, having reference to the carbonaceous group. The extent of decomposition of carbohydrates by microorganisms is found to depend not only on the nature of the organisms, but also on the nature and amount of available nitrogen, as pointed out by Waksman.[9]

Protein Decomposition

Proteins are usually available, as in the form of urea, amino acids, etc. These organic substances are fermentable to carbon dioxide and methane. Organic acids constitute a primary end-product of decomposition of the amino acids, as well as of the first stages of decomposition of carbohydrates. In a properly functioning digester, these organic acids are further broken down to carbon dioxide and methane. The material is liquefied by

SEWAGE Treatment Plant of Arlington County (Md.). Sludge digestion units are in center.

bacterial secretions known as enzymes. Liquid is absorbed in the bacterial cell, where changes occur to cause the cells to grow and multiply by splitting up into parts; each part in turn becomes a new focus of life, eventually again splitting.[10]

In his paper "The Sanitary Chemistry of Nitrogen,"[11] W. W. Eckenfelder, Jr., treats the subject of proteins and their decomposition products in detail, describing the buildup of proteins from amino acids and revealing the manner in which the protein molecule is made up of various nitrogen-containing components. The following excerpt from Eckenfelder's discussion, sets forth the basic principles involved in these processes:

"Sulfur . . . is believed to be present in two different forms in the protein molecule. The first form which is present in greatest amount, is that loosely combined with carbon and hydrogen and is variously termed unoxidized, loosely combined, mercaptan and lead blackening sulfur; the second form is combined in a more stable manner with carbon and oxygen and is known as oxidized or acid sulfur."

"Protein in aqueous biochemical solution will hydrolyze to amino acids, which may be either monobasic monamino acids . . . or diamino acids. Although some other types are occasionally found in sewage decomposition, the monamino acid is the most common and reacts neutral in solution." * * * "The diamino acids are strongly basic. The resultant mixture of these acids are hydrolytic decomposition products and are nearly neutral in solution with a strong resistance to pH change."

"The proteins are, in general, large molecules, which prevents direct assimilation of the protein by the organism" (in the digester)." * * * "The proteins are hydrolyzed by means of extra-cellular enzymes through a number of successive stages." * * * "This degradation of proteins by microorganisms, or cleavage to amino acids, is carried out by proteolytic enzymes acting outside the cell." * * * "Further decomposition is by mechanisms which appear to involve cell structure."

"According to Waksman when no oxygen is present nitrogen cannot be evolved as a gas unless it is present in a nitrate or nitrite." * * * "Nitrate nitrogen will yield the nitrogen oxides and ammonia when sufficient food is present. These reactions occur at an optimum pH 7.0 to 8.2 and are poor at pH 8.2 to 9.0 and pH 3.2 to 5.8."

"Good methane production does not occur below pH 6.8 or above pH 8.2. Anaerobic putrefaction of proteins is caused by intracellular or respiratory enzymes of which the net result is the action of the organisms on individual amino acids."

Special Considerations

Omitting for the moment consideration of whether single or two-stage digestion is to be practiced, we must take cognizance of the three general divisions in an anaerobic digestion process, according to Rudolfs:[12]

(a) Intense acid production
(b) Acid regression (digestion)
(c) Intensive digestion of more resistant materials

To the above listed divisions, there might be added a fourth, designated as a period of decreasing gasification as digestion is completed, with an increase in pH, representing a "humification" stage.

The presence of carbohydrates in any appreciable quantity accentuates the tendency towards acidity. The presence of alkaline salts, such as are found in hard waters, or in humus-like bodies associated with well-digested sludge, serves as a buffer against the development of detrimental acidities.

ADMINISTRATION building and digester. Central Delaware (Pa.) Sewage Treatment Plant.

As the organic acids formed in the first stages of digestion are neutralized by the products of alkaline decomposition of the second and third stages, activities reach an equilibrium. "The reactions of sludge digestion are biochemical in their nature and despite their complexity, there is considerable evidence that they do proceed in an orderly manner," comments E. B. Phelps.[13] The maintenance of such a "biological balance" should be the prime objective of a conscientious operator.

In actual practice, all stages of digestion are operative at one time to some extent, particularly in a primary tank, even though the process is divided into stages by operating two or more tanks in series. Care must be exercised to prevent the process from being thrown into a predominance of the first or acid stage. Proper balance can best be maintained by the frequent addition of fresh solids, and by withdrawal so regulated as to always leave some of the riper sludge available as "buffer" material.[14]

With respect to the rapidity with which this process can be expected to proceed after equilibrium has been established, E. B. Phelps says, "A rate of digestion of 10% per day yields a 90% digestion in 22 days and 95% in 28 days. Similar rates for the digestion of activated sludge are of the order of 5% per day."[13]

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W&SW

Finney Becomes Associate of Howard K. Bell Engineers

J. Wiley Finney, Jr., has joined the firm of Howard K. Bell, Consulting Engineers of Lexington, Ky., as an Associate.

Mr. Finney was employed by Tennessee Department of Public Health from December 1933 until the present, except for periods of military service and graduate study at Harvard, where he received an M.S. in Sanitary Engineering. He served in the Sanitary Corps of the U. S. Army for five years, three of which were spent in the European Theatre as Chief Sanitary Engineer with the Eighth Air Force and Headquarters U. S. Strategic Air Forces in Europe.

As Assistant Director of the Division of Sanitary Engineering, Finney was responsible for supervision of public water supplies, public sewerage systems and industrial waste treatment facilities. In his new position, he will continue his work on water supply, sewerage and waste treatment projects. Finney is currently Secretary-Treasurer of the Kentucky-Tennessee Section A. W. W. A.

Pollution in a Tidal Stream

The maximum loading of a stream is determined by properly evaluating local factors

by W. T. LAFFEY

THE intelligent approach to pollution abatement has as its purpose not an elimination of all wastes emptying into a stream, but a proper balance between the wastes added and the ability of the stream to assimilate them. Any program involving control of stream pollution requires a thorough knowledge of the stream characteristics and assimilative potential. To determine this potential, certain preliminary data must be known and developed. For a tidal river these preliminary data consist of: discharge, topography, and tidal phenomena.

Discharge data and runoff rates, frequently extending over a fifty year period, are available for most rivers in the U. S. through state or federal agencies such as the U. S. Geological Survey. These data, together with hydrographs and probability curves developed from them, are used to determine the severity and occurrence of drought flows and periods of stable discharge.

A stable discharge period during the collection of river samples is important because the samples will reflect the true conditions in the river and remain unaffected by fluctuations in flow. Statistical methods may be applied to the data to determine the most probable period of stable discharge, and this period may be tentatively set up for the sampling program.

In order to determine the extent of the survey, the time of passage should be computed from river volume and the discharge during the stable period. River volume usually may be determined from topographic maps or navigation charts. In the event these maps or charts are not available for the stretch of river being surveyed, soundings made at strategic points will furnish the necessary information. In some cases, the introduction of dye and observation of its travel will provide the information required.

Problems Caused by Tide

On tidal rivers the rise and fall of the tide presents additional problems. The direction of river flow oscillates, salinity may be introduced, and the distribution pattern of incoming wastes may be changed considerably. In the United States the tidal pattern is different on the east coast, the gulf coast and the west coast.

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His paper was presented at the 1954 Southern Industrial Wastes Conference in Houston, Texas.

Figure 1 shows typical tide curves for the three locations. On the east coast there are two complete tidal cycles during a period of something less than twenty-four hours, and the amplitude of successive cycles is approximately equal. On the gulf coast there usually is but one cycle a day. On the west coast there are two cycles a day, but the amplitude of successive cycles is unequal.

In addition to the daily fluctuation there are fluctuations due to the moon's phase and declination as shown in Fig. 2. On the east coast, for example, the amplitude increases during a full or a new moon and decreases during the first and third quarters. At the time of maximum declination of the moon the diurnal inequalities will increase considerably.

These factors must be considered in selecting the period of the sampling program and in interpreting the data collected therefrom. The constituents in the river, such as dissolved oxygen, may increase or decrease with a change in water level. In order to determine the mean value of these constituents, samples should be taken during the period when diurnal inequalities, or the difference in height of successive tides, are at a minimum. These minimum periods may be determined from tide tables data prepared by the Coast and Geodetic Survey.

A period when the diurnal inequalities are at a minimum extends for only a few days and is the period when intensive sampling should take place. Samples should be collected hourly over two or three consecutive tidal cycles, if possible. Inasmuch as collecting samples throughout the night may be undesirable, it will be satisfactory to sample or alternate cycles so that all work may be done during daylight hours.

Basic Information Needed

As mentioned previously, the time of passage usually determines the extent the river survey should encompass. However, tidal oscillations will spread incoming wastes over a large area. The size of this area is a function of the current velocity and this velocity will change with the change in high and low tide levels. If sampling were conducted at a time when the tidal amplitude was low, the effect would extend a relatively short distance upstream and downstream, the distance increasing, of course, as the amplitude increases. Tables are available that will furnish information on current velocities and the location of extreme stations to be estimated.

Other factors that affect the survey are uses of the water downstream and the character of the wastes added to the stream. Whatever the usage of the water downstream, it may well influence the constituents to be analyzed, and the number and location of sampling stations. Likewise, the character of the wastes added will influence the sampling procedure. Ordinarily, information on dissolved oxygen, B. O. D., temperature, pH, solids content and salinity is all that is required. In some cases knowledge of toxicity, hardness, nitrates or others may be useful or necessary. Where the study is for the purpose of determining the effect of wastes from a proposed plant, then the character of the contemplated wastes should be determined from other plants having similar wastes, from pilot plants, or by calculation of the process material balance.

TIDE curve cycles typical of three U. S. seaports

Locating Sampling Stations

After this basic information has been obtained, sampling stations can be located and the number and type of samples to be taken can be decided. The extreme upstream station should be located at a point that is unaffected by the introduction of wastes, and the extreme downstream station should be at a point where recovery from pollution is essentially complete. Intermediate stations should be selected so that a clear picture of deoxygenation and reaeration may be obtained.

Personnel and equipment requirements for sampling and analysis can now be determined. In the event sufficient personnel is not available within the organization, it may be necessary to secure help through other interested organizations or by obtaining outside assistance or service. Similarly, sufficient equipment, such as samplers, chemical kits, ice, boats, life preservers, must be available.

In order to determine the wisdom of selection of sampling stations, and to reduce the work to a minimum, it is well to conduct a preliminary survey. Samples should be taken at a number of points and depths at each station to determine if one sample will be representative of that station. Local conditions or peculiarities that may affect the study should be considered. Equipment and techniques can be checked and, if necessary, improved. If the analytical work is to be performed by more than one laboratory, preliminary samples may be distributed and analyzed by each laboratory and the results compared.

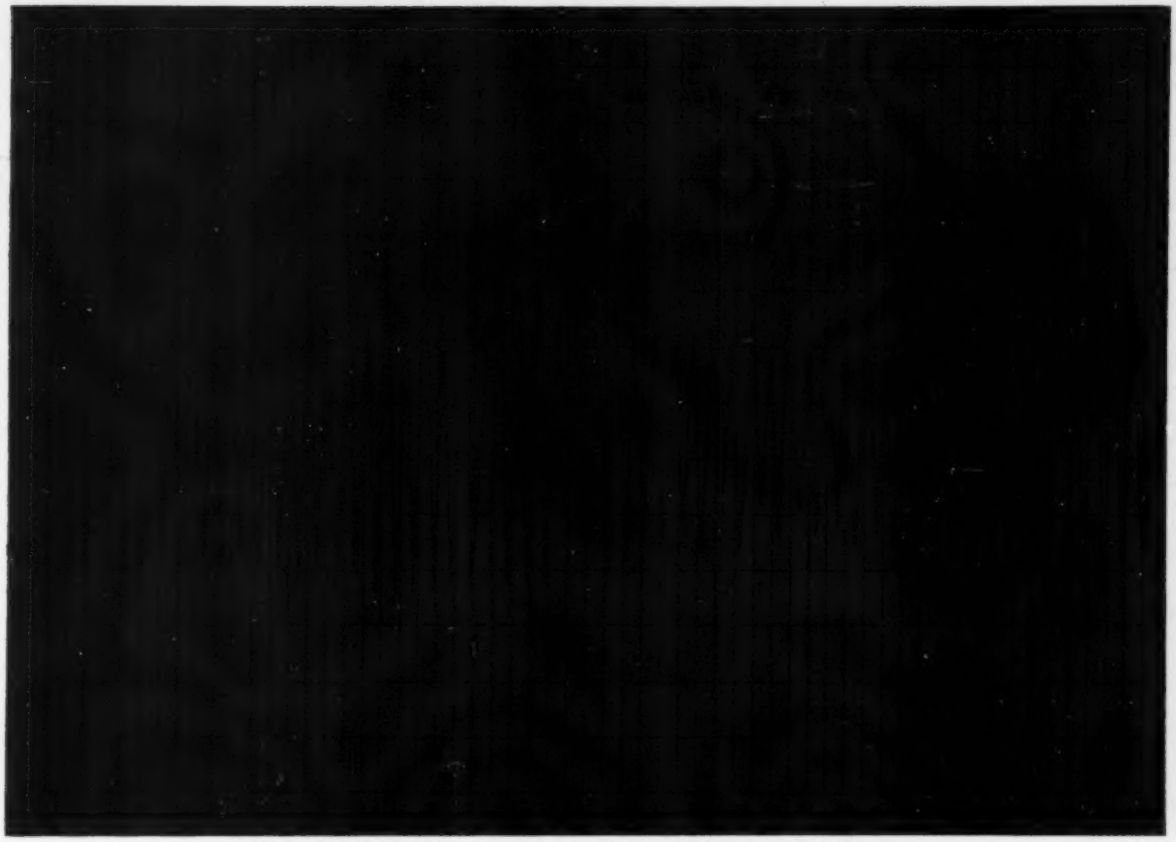
In the meantime, preparations for the full scale sampling program should be completed so that everything may be set in action when conditions are satisfactory. All personnel selected should be furnished with a check list and instructions. The equipment should be in readiness. A level gauge should be installed in the sampling area for recording river levels. Daily discharge gauge readings should be taken and the values plotted.

Sampling and Analyses

Contact with the Weather Bureau should be made for 30-day predictions, and for one- and five-day forecasts. When the river discharge has been stable for a week or two, when weather predictions are favorable and tidal conditions are suitable, all the forces must be set in action to sample as soon as possible. In addition to the river samples, plant wastes must be collected and composited, not only during the river sampling program but preceding it.

Most of the analytical work is routine. However, in addition to the regular five-day B. O. D. analyses, the immediate, 1,3, 7 and 10 day B. O. D. values of the river and waste samples should be obtained in order to determine rate curves. In the event B. O. D. samples cannot be set up immediately, they should be iced or refrigerated during storage. The dissolved oxygen samples should be "fixed" when taken, and titrated later in the laboratory. Ordinarily, special precautions are not required to determine other constituents.

With the completion of sampling and analyses, the next step is to analyze the data to determine the constituents of the river upstream, of the wastes added, and the effects of the wastes downstream. Some constituents, such as solids, are directly related to the dilution factor and can be so computed. Although the dissolved oxygen and B. O. D. content is initially a function of the dilution



FLUCTUATION of tide amplitude due to phase and declination of the moon

of the relative quantities in the river and waste effluent, there are two opposing forces that change these amounts: deoxygenation and reaeration. Deoxygenation is a function of the added waste. Reaeration is a function of time, temperature, per cent saturation, salinity, surface area and depth of water, amount of turnover, and even of the amount of nitrates or algae present. In order to determine the action and reaction to develop constants and apply these constants to other conditions, a number of techniques have been developed.

Evaluation of Data

Mathematical or graphical constants may be developed, using the typical "oxygen sag" formulas of E. B. Phelps. The observed data thus provides constants that may be used in the computation of oxygen deficit and of critical points under various conditions of flow, temperature and waste loadings. When the critical points are known, the remainder of the oxygen sag curve can be completed with reasonable accuracy.

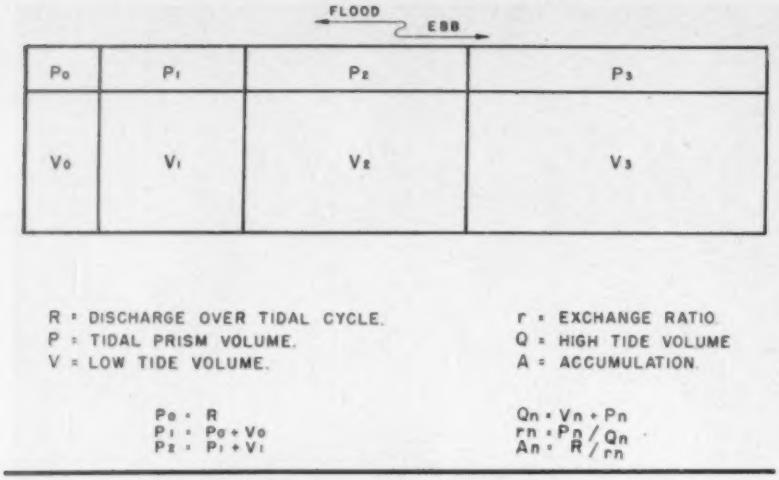
This method has been widely used, although it does have some shortcomings. Phelps recognized that the sag curve formula applies to the ideal situation in which the load is applied at one point, after which there is no further dilution or pollution. Another objection raised is that the reaeration constant is sometimes considered too general for specific cases. Despite their limitations, these formulations have been used widely and with good correlation between calculated and observed conditions.

C. J. Velz has approached the problem of computing the sag curve by separating the factors influencing reaeration and determining the values for each factor for individual stretches along the river. The oxygen deficit, mix interval, per cent oxygen absorbed per mix, and volume are each assigned separate values in the determination of aeration. In addition, certain refinements in deoxygenation are considered such as settling out of solids, B. O. D. extraction due to water borne organisms, and the effects of benthal decomposition.

Tidal River Calculations

To evaluate deoxgenation and reaeration on tidal rivers, methods previously used were similar to those used on non-tidal rivers. In a recent tidal river survey, the author and others attempted to apply a new theory (the exchange of fresh and salt water in tidal estuaries) to the solution of B. O. D. and dissolved oxygen determinations. This theory, titled "The Exchanges of Fresh and Salt Water in Tidal Estuaries," was developed by B. H. Ketchum of the Woods Hole Oceanographic Institution. In the determination of salinities along different estuaries, good results had been obtained by applying this theory.

The basic data required for the calculations are tidal heights, river discharge, and river volumes. Fundamental assumptions made are that a steady state distribution of fresh and salt water will exist if the discharge is constant, and that complete mixing will occur. The inner end of an estuary is defined as the point where the volume of the tidal prism is equal to the volume of river discharge over a tidal cycle. The tidal prism, or intertidal volume, is the volume of a segment between low and high tide. The ratio of the tidal prism volume to high tide volume is called the exchange ratio, and this is proportional to the water removed from the segment on



RIVER segmentation calculations for flood and ebb tide conditions

the ebb tide.

As the inner end of the estuary is the point where the volume of the tidal prism is equal to the discharge over a tidal cycle, the limits include Segment 0. The volume of each successive segment at low tide is equal to the volume of the previous segment at high tide.

Referring to Fig. 3, if P represents the tidal prism, P_0 is equal to the total discharge R. The low tide volume for Segment 0, V_0, can then be determined. The high tide volume, of course, is the sum of the two, and also is equal to the low tide volume of the following segment, V_1. Successive segments are determined in the same manner. The exchange ratio, r, is determined from the ratio Pn/Qn.

The river water removed from any segment may be calculated by the exchange ratio. Similarly, the removal of any constituent such as salinity, B.O.D., or dissolved oxygen may be computed, assuming no other action takes place except the interchange of water. Of course, the B.O.D. decreases as the decomposition of the organic matter proceeds, and this in turn affects the dissolved oxygen. In addition, the dissolved oxygen content may be increased or decreased by reaeration, by change in solubility due to temperature or salinity, and by the algae effect.

B. O. D. Considerations

In the determination of the B.O.D. content, the total incoming B.O.D. is equal to that added by the river and the plant wastes. The ultimate B.O.D. for each is computed and the total accumulation in any segment is equal to the discharge divided by exchange ratio, or $A_n = R/r_n$. Knowing the ultimate B.O.D. and the rate constant, the B.O.D. exerted over the tidal cycle is determined from the monomolecular formula $X = L(1\text{-}10^{-kt})$. Part of the B.O.D. not oxidized will pass along to the next segment, in proportion to the exchange ratio and to the accumulated B.O.D. and exerted B.O.D. similarly determined for that segment. By dividing the amount of B.O.D. remaining in the segment after flushing of the tidal cycle by the weight of water in the segment, the ultimate B.O.D. in ppm and also the 5-day B.O.D. is determined from the monomolecular formula.

The dissolved oxygen content is computed by determining the total incoming amount and the accumulation, subtracting the amount due to deoxygenation and attributing the difference between this value and the observed value of reaeration. In one instance studied, consideration was not given to algal effects because it was considered they played a negligent part in reaeration. Inasmuch as the temperature and salinity varied little, these factors also were not considered to have a measurable effect on aeration.

The amount of B.O.D. and dissolved oxygen varies over a tidal cycle at any one point, but the amount follows a pattern based on the time of the cycle. When plotted, the values resemble a sine curve. At the time of high tide, or the slack of flood, the B.O.D. is at a minimum and the dissolved oxygen at a maximum for any one section. Conversely, at low tide the B.O.D. has a maximum value, and the dissolved oxygen a minimum. In effect, the river has been displaced up or down stream an amount dependent on the range in tidal fluctuation. In determining B. O. D. and dissolved oxygen values of a specific instance, mean values were considered and results extrapolated for minimum and maximum conditions. The computed and observed B. O. D. values checked very closely under a number of different conditions.

Lack of D. O. Correlation

When the dissolved oxygen content was computed, there was no correlation for any stretch of the river under different conditions; reaeration values for adjacent segments varied widely, even though all conditions would indicate that the reaeration values should agree fairly closely. As a matter of fact, in one instance the reaeration rate had a negative value. This might have been explained if there were benthal deposits in that segment; but it was known that the velocities in this segment were higher than in others, thus deposition was unlikely. Also, bottom samples indicated a sandy bottom with little or no organic matter present.

The fact that correlation between calculated and observed values of B. O. D. was good, and of dissolved oxygen poor, indicated a possible deficiency in dissolved oxygen calculations. Therefore, a considerable amount of time was spent in re-evaluating the methods used and in considering other factors such as volume, current velocity, effective surface area, depth, turnover and mix interval, but to no avail. Unfortunately, we do not yet have the answer.

It might be of interest to relate an experience Dr. Ketchum had recently, in the determination of salinities on another tidal river. He found that the calculated values compared favorably with observed values below the point of salt intrusion but not at all above that point. Inasmuch as our study was above this point of salt intrusion, it may be concluded that the theory is not valid even though the B. O. D. calculations indicate otherwise. Whether the theory can be applied below the point of salt intrusion for B. O. D. and for dissolved oxygen determination, has not (to the author's knowledge) been determined at this time.

Although much energy was expended in developing Ketchum's theory, it was never considered that other methods were by any means invalid. Rather, it was our intention to develop a method applicable to a particular situation; especially a method that would provide more accurate and predictable information.

In any particular river study, local factors may have peculiar effects that must be considered. For example, wastes discharged into a bay may possibly be retained there for some time before entering the channel. If this

occurs, the B. O. D. may be reduced considerably (as in a lagoon), and the load entering the channel would be lower than indicated by the effluent composite samples. The flow pattern from the bay to the channel should be determined in order that the waste loading may be properly integrated.

In the location of an outfall, consideration must be given to the possibility of the wastes "blossoming out," and thus forming a barrier in the channel through which fish could not penetrate. It would be folly to remove pollution from a bay and bypass it to a channel where it would definitely be detrimental. The depth of the outfall may be important if the density of the river water and that of the wastes differ. Ordinarily, if the density of the waste is lower than that of the river, an outfall located near the bottom is indicated in order that mixing can be accomplished with a minimum of energy. If, however, the temperature of the waste is higher, then the density may be increased in cooling by the river; the waste may then flow along the bottom. To assist in selecting the optimum depth of the outfall, the densities of waste and of river water should be determined over a range of temperature. The points of equal density should then be plotted. A study of the resulting curve can aid materially in the design of the outfall.

The importance of a thorough study *prior* to the sampling program, and the need for detail in conducting the program cannot be over emphasized. A river survey represents a sizeable investment that can be completely wasted if it is inadequately prepared or haphazardly conducted. A good survey will benefit all concerned. When a stream is properly used, the public will have a natural resource in a suitable condition for their needs; at the same time those who require the river for disposal of liquid wastes can utilize this natural resource to its capacity. **W&SW**

Most Important in Diesel Operation*

Good Water and Proper Lubrication

On the whole the two requisites that are *most* important in the operation of a Diesel engine are:

1. Lubrication
2. Cooling Water

Although lubrication is the more important of the two, they are interrelated. For instance, I have in mind a Diesel of well-known make that was allowed to operate for a period of time that was too long with a cooling water temperature in the vicinity of 200 deg. F. If the cooling water had been distilled, or even conditioned, it wouldn't have been so serious, but this water was "bad"; it wasn't treated in any way.

Scale accumulations built up in the cooling jacket, of course, and clogged the passages. That led to high cylinder wall temperatures and the lubricating oil couldn't function properly. And, that is where cooling water and lubrication are inter-related. The pistons stuck, scored the walls, and wore excessively.

Finally an "expert" was called, and it didn't take him long to put his finger on the cause of the trouble—the scale forming cooling water.

But, going back to lubrication, have you ever noticed on reading through your Diesel operating manual that lubrication is mentioned oftener than anything else? That, in a way, emphasizes its importance. Lubrication is what keeps the engine from wearing out quickly. All other conditions being right, lubrication is what permits the Diesel to operate at its remarkably high efficiency.

Lubrication Can Be Overdone

There is such a thing, too, as giving a Diesel "too much" lubricant, believe it or not. It is well to be careful about that point although too much is better than too little. By giving the engine too much oil, carbon deposits will be formed. If such deposits persist in forming, don't blame the lubricating oil, blame yourself. The best way to oil a Diesel engine is to use a force feed lubricator, feeding the oil directly onto the piston between the piston rings. Attach the lubricator to the engine and mechanize it in such a way that the amount of oil fed is in direct proportion to the number of strokes. Feed the oil against the piston while it is at the end of its stroke so that the oil will "catch" and so that it will not either blow out or be sucked out.

The color of lubricating oil has nothing to do with its capacity to lubricate. Therefore, don't be enticed into buying a "good-looking" oil simply for its looks. The lubrication problem is well worth studying carefully. Study both the lubricant and your engine and when the lubrication problem is once solved you will be surprised at the small amount of attention that the engine will demand of you. To flood an engine cylinder with oil may eliminate much of the friction but on the other hand, it may cause serious and costly trouble.

*Contributed by W. F. Schaphorst, M.E. Newark, N.J.

Utility Appeals P.S.C. Ruling as First Action in 22 Years

A small water company in southern Connecticut filed recently the first court appeal in twenty-two years from a rate decision of the State Public Utilities Commission. The Guilford-Chester Water Company, which operates in towns near New Haven, filed the appeal after the commission turned down the full amount of a requested rate increase.

The appeal papers asserted that the decision "compels the appellant to furnish water service under circumstances which will bring it no just return and deprives it of its property without due process of law."

Dr. Victor L. Streeter At Univ. of Michigan

In September, Dr. Victor L. Streeter assumed his new duties as Professor of Hydraulic Engineering in the Department of Civil Engineering of the University of Michigan. Until this spring, Professor Streeter was Research Professor and Director, Fundamental Fluids Research, Illinois Institute of Technology, and Consultant in Mechanics to Armour Research Foundation.

He was graduated from the University of Michigan College of Engineering with the degree B.S. (C.E.) and obtained the M.S.E. and Sci.D. degrees from this institution. He studied fluids in Germany during 1935 and 1936 as a Freeman Scholar and more recently spent a year at Civil Engineering Department of the National School of Engineering, University of New Zealand as a Fulbright Visiting Lecturer.

New Use for Water . . .

George Frantum, a service station attendant, told Baltimore police he was washing a car recently when a man approached him from behind and said, "Gimme your money."

Frantum said he whirled around and squirted water in the man's face. The would-be holdup man gave a yell and fled.

Gas from Sewage Sludge

Eleventh in a Series

by DON E. BLOODGOOD

Mr. Bloodgood is Professor of Sanitary Engineering, Purdue Univ., Lafayette, Ind. In this series, he discusses *Sewage Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

IN the process of sludge digestion, carried on by anaerobic bacteria, the gases produced are important by-products. As the organic solids that are decomposed by the bacteria consist of carbon, hydrogen, oxygen, nitrogen and sulfur, it is not surprising to find these elements in the gases. Certain elements remain in the sludge as complex compounds, but the gases liberated are simpler compounds and are made up of only one or two of the elements.

The element carbon in sewage solids combines with hydrogen to form methane gas. The carbon also will combine with oxygen of the solids to form carbon dioxide.

It can readily be deduced that the relative percentage of methane and carbon dioxide in the gas released from digesting sewage solids is controlled by the nature of the organic matter being decomposed. If the organic matter contains more hydrogen than oxygen, then one can always expect to find more methane than carbon dioxide in the gas produced. The quantities of free oxygen and nitrogen contained in sewage gas usually can be attributed to air carried into the digestion tank with the sludge or entering through a faulty device on the tank, or to the incorrect operation of some satisfactory piece of equipment. If the quantity of nitrogen in sludge gas in five times the quantity of oxygen present, it is reasonable to believe that air is entering the tank in some manner.

Sometimes a small quantity of hydrogen is reported as present in sewage gas, usually a quantity so small as to be of no consequence. Certainly any hydrogen present will burn without difficulty.

Sludge Gas Characteristics

The carbon dioxide, methane, and hydrogen gases produced by the digestion of sludge have little or no odor. One gas produced, hydrogen sulfide, has a very strong odor that can be detected in concentrations as low as 0.001 per cent. Not all sewage sludge gas contains hydrogen sulfide. When hydrogen sulfide is found in sludge gas, it may be assumed either that the sulfur was derived from proteins in the sludge or that the water carrying the sludge solids is high in sulfates. In some instances no hydrogen sulfide is formed even when proteins are decomposed in the digestion tank. The digestion process is complex, and the resulting decomposition products cannot always be accurately predicted.

The methane in gas produced by digestion usually comprises about 68 per cent of the total volume, and the carbon dioxide about 32 per cent.

Methane weighs 16.03 grams, and carbon dioxide weighs 44 grams for each 22.38 liters. On the basis of 68 per cent methane and 32 per cent carbon dioxide, one thousand cubic feet of gas would weigh 97.5 pounds. For each 1000 cubic feet of gas produced, an equivalent weight of solids will be removed from the sludge in the tank.

During the digestion process, some oxygen and hydrogen from the organic solids is believed to be changed to water, but the amount has never been reported to be significant.

The gases produced mix thoroughly; they do not seem to separate even though the carbon dioxide is 2.75 times as heavy as the methane. The weight of the mixed gases produced in sewage sludge digestion is such that sludge gas rises the highest point in digestion tank or any other enclosure.

Carbon Dioxide and Methane

Methane is a colorless, odorless, tasteless and non-poisonous gas. It is the principal combustible portion of sewage sludge gas, and thus is potentially hazardous.

Carbon dioxide also is colorless and odorless, but it will not burn. It is a potential hazard because, in concentrations greater than 10 per cent, it acts on the nerves that control breathing, and a few minutes exposure will cause suffocation. The presence of either methane or carbon dioxide in air dilutes the oxygen available to support life; as a consequence, it may be found that there is not enough oxygen available for breathing. It is obvious that these two major gases produced in sludge digestion should be recognized as dangerous and handled with caution.

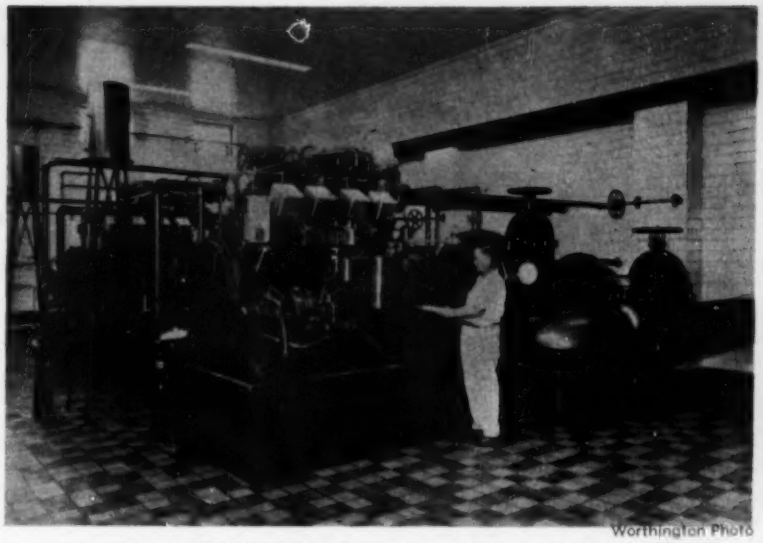
Methane burns and supplies the fuel constituent of sludge gas. Sewage sludge gas usually has about the same heat value as manufactured city gas, and about 0.65 times the heat value of normal natural gas. The heat value is measured in British thermal units, commonly called B.t.u. One cubic foot of sewage sludge gas has a heating value of about 650 B.t.u. A thousand cubic feet of the gas is equal in heating value to 5.2 gallons of gasoline, or to 4.6 gallons of Diesel oil.

Gas Collections

The gas liberated by micro-organisms in the digestion process is in the form of minute bubbles; these collect to form larger bubbles that rise through the digesting

sludge. The evolution of gas so stirs the sludge that, in a digestion tank where great biological activity is going on, there is a "boiling" action of the sludge contents.

The gas evolved collects under the cover of the tank and moves to the collecting dome. From the dome, gas is conducted by pipe line to the point of use. The two types of digestion tanks most generally used are those with fixed covers and those with floating covers. Floating covers are of two kinds: The cover may float directly on top of the liquid allowing very little space for gas collection, or there may be a large space within the cover for collecting and storaging the gas. In the latter unit, the cover floats on the tank contents like an inverted bowl. In the first type, the cover floats like a boat.



Worthington Photo

TWO 134 H.P. ENGINES driving 12 mgd sewage pumps at Roanoke, Va.

Moisture Traps

Upon leaving the liquid, the gas is warm and carries considerable moisture with it. When the gas cools in passing through pipe lines, the water condenses. So much condensate collects that it is necessary to provide traps in the gas lines; by this means, the moisture can be easily and quickly drained away. Most installations designed to utilize sludge gas are equipped with the necessary traps, but too often the plant operators neglect to drain the traps. It is necessary that all the sludge gas lines be installed with adequate slope so as to permit draining moisture to traps. The operators of sludge digesters should develop schedules for the periodic draining of traps.

Moisture sometimes collects in the metering devices and may put them out of operation. The relative temperature of the tank contents and the air temperature will govern the amount of condensate which collects, thus there will not be the same amount of water to be removed from traps at all seasons of the year. The operator may find only a small amount of water in condensate traps upon one of his inspections; this does not indicate that he should discontinue inspections or increase the length of time between inspections. There may be considerable moisture collected in the traps after the next short period.

Gas Hazards

Sewage sludge gas is as potentially dangerous as city gas, gasoline, or the bottled gases. One is not inclined to treat sewage gas with proper respect until he has seen the destruction resulting from a sludge gas explosion. Most sewage treatment plants are designed with the flame traps necessary for proper protection.

Every plant operator should be thoroughly familiar with the function of flame traps in his plant, and he must be sure that nothing happens to interfere with their operation. Great care should be exercised when making changes in gas piping, so that the altered piping will not make flame traps ineffective.

Explosions of sewage gas have been powerful enough to demolish brick buildings and to hurl slabs of concrete a distance of several hundred feet.

It is desirable to use all the gas produced in sewage sludge digestion, but this is not always possible. The requirements for gas and the rate of gas production generally are not the same and, as a consequence, some gas must be wasted. As the potential hazard of sludge gas has been described, it is obvious that special precautions must be taken to dispose of the waste gas in a safe manner. It is dangerous to discharge waste gas to the atmosphere, because it will not always dissipate rapidly or become sufficiently diluted with air to make it harmless. The liberated gas might be carried into buildings where, of course, it could be very dangerous.

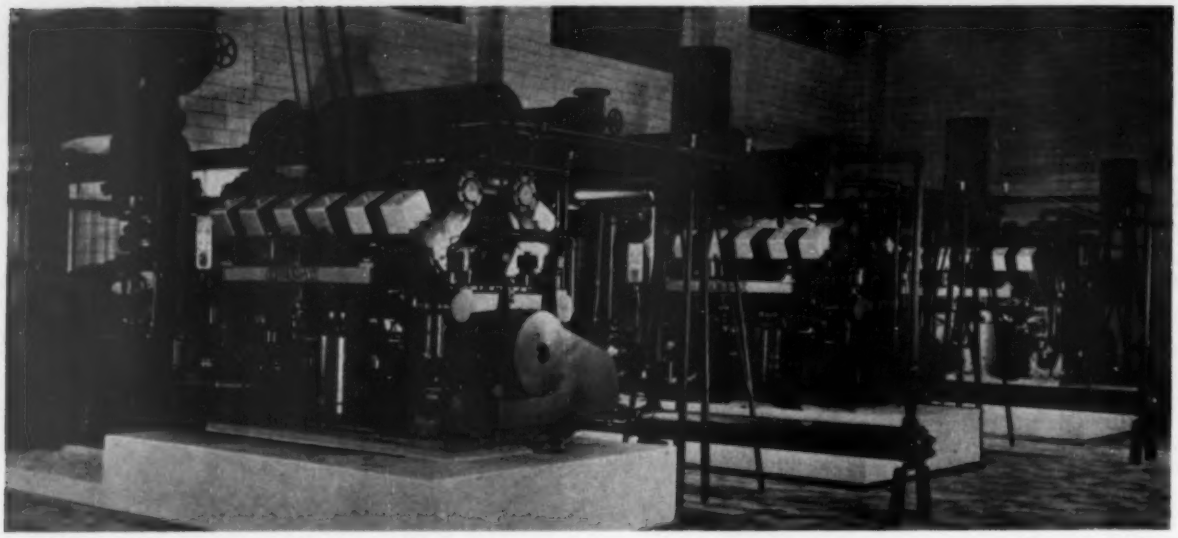
MODERN gas storage spheres
Hammond, Ind., sewage plant

Waste Gas Burners

Waste gas burners should be provided at a location some distance from the digestion tanks and the gas storage. Periodic checks should be made to see that the pilot burner is lighted at all times so that any excess gas will be burned. Burning gas is not readily visible in daylight, but it can be seen at night. A glance at the waste burner when the operator makes a night visit to his plant often will tell him whether or not the waste gas burner is operating. If a waste gas burner operates much of the time, the plant operator should try to determine ways to put the excess gas to use.

Uses of Sludge Gas

Probably the first use of sewage sludge gas in the United States was in 1915. In that year, Hommon collected gas from the Imhoff tanks at Atlanta, Georgia. The first sep-



THREE 220 H.P. gas engines, each driving a 5000 cu. ft. blower at Roanoke Sewage Treatment Plant Climax Photo

arate sludge digestion tank providing gas collection was put into operation at Antigo, Wisconsin, in 1926.

Sewage sludge gas may be burned in a furnace or used to operate a gas engine. The gas burns with a blue flame. There are more installations where sewage sludge gas is burned in heaters than there are installations where the gas is used to operate engines. However, it is probable that a larger volume of gas is consumed in operating gas engines than is burned in heaters; this is because of the general use of gas engines in the larger sewage treatment plants.

The gas heaters used for burning sewage gas are very much like those used for burning city gas. From the outside they appear exactly alike; there is, however, some slight difference in the burners. Sludge gas burns without smoke, so that there is no problem in keeping the inside of the furnace clean. Most of the heaters are of the hot water boiler type. The heated water is used to heat buildings, and to maintain sludge digestion tanks at the desired temperature of 85-95° F.

Gas Driven Engines

Gas engines operate with sewage gas in much the same manner that they do with natural gas. There is no need for a carburetor, as the proper gas mixture can be obtained by admitting air to the engine intake manifold.

Gas engines are used to drive sewage pumps, air compressors (for activated sludge), and electric generators (for power production). Sewage pumps driven by gas engines have a wide range of capacity because the speed of the gas engine can readily be changed. In some instances, floats have been used to operate the engine accelerator. When this is done, as the flow increases, the head in the wet well rises and the engine is made to run faster; of course, the reverse is true when the flow decreases. A pumping rate control of this type causes no sudden fluctuations in the rate of flow through the sewage plant. There are disadvantages, however, to operating centrifugal pumps at variable speeds, because there is one speed at which they have their highest efficiency.

Electric generators and the air compressors are operated at a constant speed and therefore use gas at a uniform rate. Inasmuch as the gas is not produced at a uniform rate from day to day, and as varying numbers of generators and compressors may be used, it is quite necessary to provide considerable gas storage to supply the engines at all times.

Sewage gas has been used in several other ways; perhaps the most novel uses have been to operate gas refrigerators and automobiles.

Hydrogen Sulfide

Particular attention is called to hydrogen sulfide gas because it may be the cause of serious trouble in a sewage plant. If this gas is present in the sludge gas produced in digestion tanks, it may cause considerable corrosion. Either moisture combined with hydrogen sulfide, or the combustion of hydrogen sulfide (in a heater or gas engine), produces corrosive acids that attack furnace and engine parts.

Hydrogen sulfide is not present in a significant concentration in all sewage sludge gas. When hydrogen sulfide is present, it may be necessary to provide gas scrubbing to remove this constituent before using the sludge gas. Hydrogen sulfide can be removed by passing the sludge gas through wood shavings coated with ferrous oxide. A scrubber of this type is simple and effective; it is not expensive to operate because the material in the scrubber can be regenerated by exposure to air; care must be taken to prevent the wood shavings from catching fire.

Summary

1. Sewage sludge gas is produced by the action of bacteria in decomposing of organic solids.

2. Carbon dioxide and methane are the principal gases comprising sewage sludge gas.

3. The decomposition of at least 97.5 pounds of organic solids is required to produce 1000 cubic feet of sludge gas.

4. Sewage sludge gas is a potential explosive and must be handled with great care.

5. Waste gas burners must be located properly and maintained in good operating condition.

6. Sewage sludge gas is a useful and valuable fuel.

7. Hydrogen sulfide should be removed from sludge gas before using the gas in heaters or gas engines.

W&SW

EXPLODED view illustrating how the flexible bulb type of electrode well is constructed

Trouble-Free Sewage Pump Controls

A plastic beach-ball is the basis of this electrode well which Los Angeles finds inexpensive and reliable

by E. G. STUDLEY

THE CITY of Los Angeles has a sewerage system which is of the gravity type. However, there are certain areas where it is necessary to pump sewage into the collection system. For this purpose, Los Angeles now has in operation 28 sewage pumping stations, and plans are under preparation for two new pumping plants. Most of the pumping stations are relatively small and do not warrant continuous attendance by an operator. It is common practice to have several pumping stations assigned to a single operator, thus the pumping plants are unattended for the majority of the time. It is important, therefore, that controls of motors operating the sewage pumps be as trouble-free and as reliable as possible.

The conventional floats operating in stilling wells caused so much trouble that they were abandoned for the control of motors. To replace the original float controls, electrodes of our own design were installed in the stilling wells.

Mr. Studley is Engineer of Sewer Design, Bureau of Engineering, City of Los Angeles, California.

The new electrode controls are relatively simple and have provided satisfactory service over a period of years. The principal difficulty experienced in operating the new controls is caused by the formation of scum in the stilling wells; this condition requires the removal of electrodes and the washing of wells with a high pressure water jet. This same operating problem is encountered where float controls are still in use.

In recent years there has been an increase of grease and floating material in the sewage. As a result, more frequent cleaning of the stilling wells has been required, in some cases as often as once a day. Therefore, an effort was made to find a method of pump control which would be dependable without extensive maintenance, which would be inexpensive, and which could readily be adapted to existing installations.

New Control Designed

Various ideas, including the proposals of several manufacturers of pump controls, were examined and

rejected as not fully meeting the stated requirements. The device developed by our Bureau of Engineering as a result of studies is simple and inexpensive and promises to provide the solution to our pump control problems. It consists of a plastic tube (1.5-in. to 2.0-in. in diameter) attached to a flexible plastic ball filled with fresh water.

The plastic tube is clamped to a convenient part of the structure, and the ball is submerged near the bottom of the wet well. The fresh water then rises in the tube to the same level as that of sewage in the wet well. Electrodes are attached to insulated wires and lowered into the tube to levels desired for starting and stopping the pumps, as indicated in the schematic diagram.

The size of the ball must be adequate to contain enough fresh water to fill the tube to the highest control level desired before the ball is completely collapsed. At the lowest level of sewage, the ball should be slightly less than full; this allows electrode settings to be made as low as the bottom of the tube. A teaspoon of copper sulphate crystals added to the fresh water inhibits the growth of slime, and also provides increased electrical conductivity.

The fresh water within the plastic ball must be electrically "grounded" to the sewage. Grounding is accomplished by using stainless steel bolts and plastic flanges to attach the plastic tube to the ball. This is illustrated in the head photograph and in the schematic diagram.

SCHEMATIC diagram illustrating conventional type (left) and flexible bulb type (right) electrode controls

PLASTIC ball and tube inside typical wet well (note scum)

The experimental model was installed in a pumping station wet well on August 3, 1953. Electrodes were connected through a relay to a recording device which simulated pump starts and stops. The device produced a chart which could be compared to the regular pump operation chart for the plant.

This model operated for a month without failure and without attention, although the conventional stilling well required cleaning every day.

No Maintenance Required

The experimental model was next connected to the controls of one of the pumps and has operated continuously since September 7, 1953, without any maintenance being required. Such good performance was not expected because the ball used was a thin, inexpensive, beach ball and larger in size than necessary. Note in the small photograph the conditions existing inside a wet well in which plastic balls were installed.

Due to the flexibility of the plastic pipe, the ball moved with wet well currents as much as one foot from the vertical position; it also became completely covered with a tangle of rags but still continued to function perfectly.

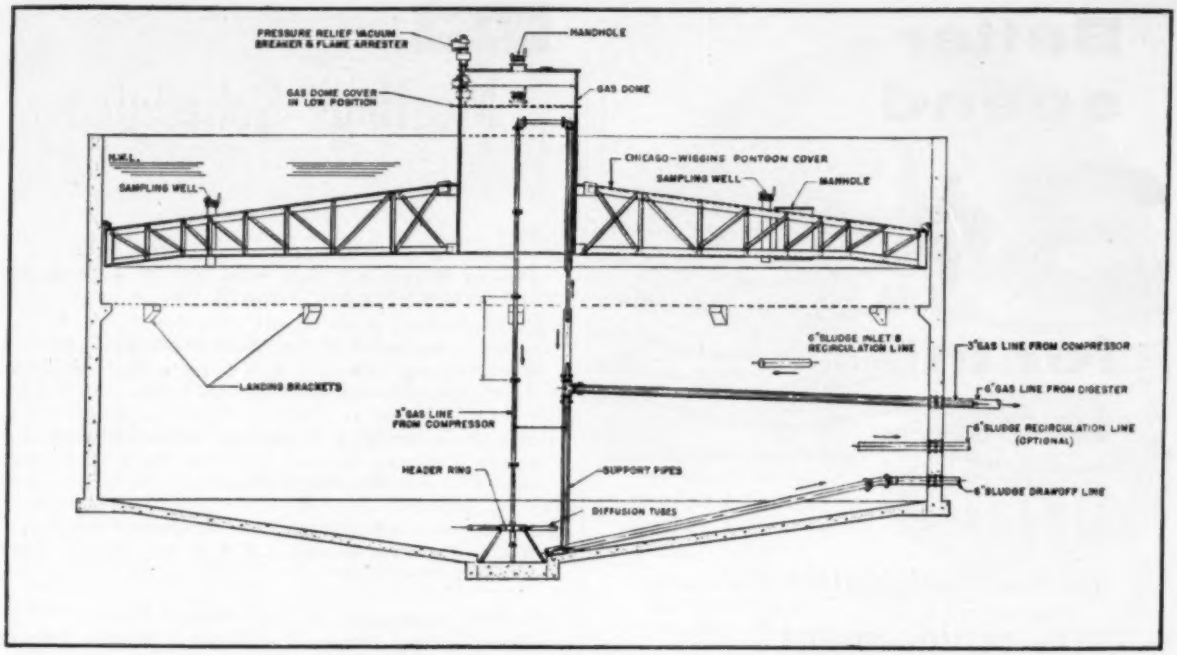
Replacement of plastic balls within a few years may be necessary. However, the cost of replacement is negligible compared to the cost of servicing the conventional type of electrode wells.

The design of new construction, including remodeling of existing installations beyond the scope of normal maintenance, is a function of the Sewer Design Division, Bureau of Engineering, headed by Lloyd Aldrich, City Engineer. J. K. Rice is in charge of mechanical design.

For design and development of the control apparatus described in this article, Raymond G. Martin, Civil Engineering Associate, was responsible.

Maintenance and operation of pumping plants is a function of the Bureau of Sanitation. Employees of that Bureau cooperated in the experimental installation, and have since constructed and installed additional units.

W&SW



Cross section of a digester with floating covers designed for operation under the CATALYTIC REDUCTION PROCESS. Similar layout applicable to fixed cover digesters.

Proved in Use . . . Accelerated Sludge Digestion

CATALYTIC REDUCTION PROCESS
(Patents Applied For)

- **INCREASES DIGESTION RATE 3 TO 4 TIMES**
- **TRIPLES EXISTING DIGESTER CAPACITY**
- **PREVENTS FLOATING DIGESTIBLE SOLIDS**
- **CUTS NEW PLANT TANK REQUIREMENTS ⅔RDS**

By providing accelerated digestion, the CATALYTIC REDUCTION PROCESS offers the only fundamental and satisfactory method for preventing deep surface accumulation* of digestible solids that are symptomatic of inadequate digestion. CRP simultaneously accelerates and uniformly digests ALL digestible solids.

*Sometimes inclusively and erroneously termed "scum"

REPRINTS

Reprints of a paper by Professor P. F. Morgan on the development of the CATALYTIC REDUCTION PROCESS and a paper by Mr. James H. Bladgett describing actual use at Columbus, Ohio are available on request.

The Only Proved Process for Accelerating Biological Digestion

Originating in 1946, the PROCESS was developed, tested and verified over six years on both laboratory and plant scale. The results have been proven in full scale plant operation at the Columbus, Ohio and Erie, Pennsylvania Sewage Treatment Plants. The PROCESS is now being installed in seven other cities. THE CATALYTIC REDUCTION PROCESS applied to one 70′ tank at the Columbus Plant digested 3.38 times the quantity of sludge solids digested in a similar tank in parallel operation not using the PROCESS. The tank operated under the PROCESS produced a reduction of solids within established ranges, normal gas production and readily driable odorless sludge.

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SEWAGE EQUIPMENT DIVISION
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Flush Bloom, Screw-Feeder, Plunger Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers

Spiral Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors

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before you spend thousands for pipe replacement!

If you are considering replacing clogged pipe or water mains with new pipe, why not find out first how much you can save by having Flexible clean that pipe...

- • • YOU SAVE ON THE COST OF NEW PIPE
- • • YOU SAVE ON PUMPING COSTS
- • • YOU SAVE ON INSURANCE RATES
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Whatever your next job may be—send today for Flexible's preliminary job cost estimate form. Flexible's long experience in cleaning pipe from 2 inches to 12 feet in diameter at 1/7th to 1/30th the cost of pipe replacement (depending on pipe size) means a substantial saving. Clogged pipes cleaned by Flexible have been restored to 90% of new pipe efficiency.

Send today for your preliminary job estimate form. We'll be glad to provide our estimate for your particular job, without cost or obligation.

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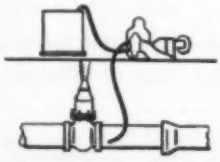
Flexible has specialized equipment and crews. Write for details!



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pipe cleaning company

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W & SW

Meetings Scheduled

Nov. 7-10—St. Petersburg, Fla. *(Soreno Hotel)*
FLORIDA SECTION A.W.W.A. Sec'y, Wm. W. Aultman, Box 316, Coconut Grove Sta., Miami 33, Fla.

Nov. 8-9—Huntington, W. Va. *(Hotel Prichard)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston 5, W. Va.

Nov. 8-10—Asheville, N. C. *(George Vanderbilt Hotel)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, E. C. Hubbard, P.O. Box 2091, Raleigh, N. C.

Nov. 9-10—Colorado Springs, Colo. *(Broadmoor Hotel)*
ROCKY MOUNTAIN SECTION A.W.W.A. Sec'y, Geo. J. Turre, Box 600, Denver, Colo.

Nov. 9-10—Huntington, W. Va. *(Prichard Hotel)*
WEST VIRGINIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, G. O. Fortney, State Dept. of Health, Charleston, W. Va.

Nov. 11-12—McCook, Neb. *(Keystone Hotel)*
NEBRASKA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Paul W. Mousel, 602 West B Street, McCook, Neb.

Nov. 15-20—Stillwater, Okla. *(Student Union Bldg.)*
OKLAHOMA WATER, SEWAGE & INDUSTRIAL WASTE CONFERENCE. (Annual Meeting). Sec'y, H. J. Darcey, State Dept. of Health, Oklahoma City, Okla.

Nov. 17-19—Allerton Park, Ill. *(Univ. of Illinois)*
ILLINOIS WATER WORKS MANAGEMENT SHORT COURSE. Director, Dr. T. E. Larson, State Water Survey, Urbana, Ill.

Nov. 18—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly Meeting). Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

Nov. 28-Dec. 3—New York, N. Y. *(Statler Hotel)*
AMERICAN SOCIETY OF MECHANICAL ENGINEERS. (Annual Meeting). Sec'y, C. E. Davies, 29 West 33rd St., New York, N. Y.

Dec. 2-4—Havana, Cuba *(Sociedad Cuban de Ingenieros)*
CUBAN SECTION A.W.W.A. Sec'y, Laurence H. Daniel, Baratillo 9, Havana, Cuba.

Dec. 8—Winthrop, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Dec. 16—Boston Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. (Monthly Meeting). Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

Jan. 18, 1955—New York, N. Y. *(Sheraton Hotel)* Grand Ballroom
NEW YORK SECTION A.W.W.A. (Mid-Winter Luncheon Meeting). Sec'y, Kimball Blanchard, 56 Grand Street, White Plains, N. Y.

Jan. 20—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

Jan. 20-21—New York, N. Y. *(Hotel Belmont Plaza)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, R. C. Sweeney, 21 No. Broadway, White Plains, N. Y.

Feb. 9-11—Indianapolis, Ind. *(Lincoln Hotel)*
INDIANA SECTION A.W.W.A. Sec'y, R. J. Becker, 1330 W. Michigan Street, Indianapolis, Ind.

Feb. 17—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos C. Knox, 204 Tremont Bldg., Boston, Mass.

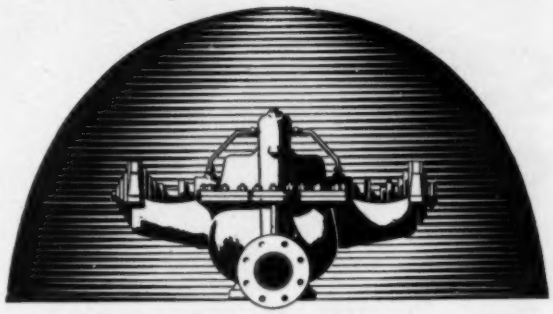
Mar. 21-23—Savannah, Ga. *(DeSoto Hotel)*
SOUTHEASTERN SECTION A.W.W.A. Sec'y, N. M. de Jarnette, 245 State Office Bldg., Atlanta, Ga.

Apr. 13-15—Hutchinson, Kans. *(Baker Hotel)*
KANSAS SECTION A.W.W.A. Sec'y, H. W. Badley, 119 West Cloud, Salina, Kans.

Apr. 13-15—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, Univ. of Nebraska, Lincoln, Neb.

Apr. 14-16—Chandler, Ariz. *(San Marcos Hotel)*
ARIZONA SECTION A.W.W.A. Sec'y, Q. M. Mees, Univ. of Arizona, 721 N. Olsen Ave., Tucson, Ariz.

Apr. 18-20—Quebec, Can. *(Chateau Frontinac)*
CANADIAN SECTION A.W.W.A. Sec'y, Dr. A. E. Berry, Dept. of Health, Parliament Buildings, Toronto, Ont., Can.



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(Title 39, United States Code, Section 233)

Of Water & Sewage Works, published monthly at Lafayette (Tippecanoe County), Indiana, for October, 1953.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Edward Scranton Gillette, 185 North Wabash Avenue, Chicago 1, Illinois; Editor, Linn H. Enslow, 155 East 44th St., New York 17, N. Y.; Managing Editor Harry A. Faber, 155 East 44th St., New York 17, N. Y.

2. The owner is (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.): Scranton Publishing Company, 185 North Wabash Avenue, Chicago 1, Illinois; E. S. Gillette, 185 North Wabash Avenue, Chicago 1, Illinois; C. T. Gillette, 185 North Wabash Avenue, Chicago 1, Illinois.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required from daily, weekly semiweekly, and triweekly newspapers only.)

EDWARD S. GILLETTE
(Signature of Publisher)

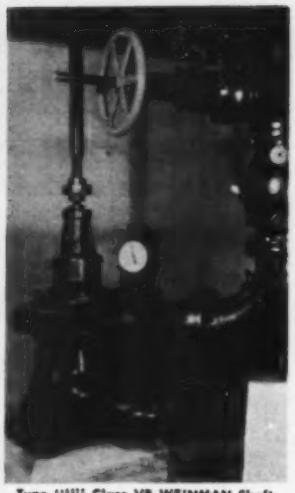
Sworn to and subscribed before me this 4th day of October, 1954.

[SEAL]

W. N. CROSSLAND, Notary Public
(My commission expires March 11, 1956)

SERVICE PROVEN

by years of use under the most gruelling conditions!



Type "U" Class VB WEINMAN Shaft-Driven Vertical Centrifugal Pump

WEINMAN

type "U" vertical

NON-CLOGGING PUMPS

The Type U, Class VM Vertical Centrifugal Pump is identical in construction details with the Class VB . . . except that impeller is carried on motor shaft. Either requires less floor space for mounting than horizontal designs, allowing comparable savings in foundation costs.

Efficient and dependable under the heaviest loads, Weinman Type "U" Non-Clogging Centrifugal Pumps easily handle liquids of varying viscosity, plus those containing extremely large amounts of foreign material suspended in sludge form. The non-clogging operation of Weinman Type "U" Pumps is especially valuable when large solids or masses of flocculated sediment are being carried.

Where pumps of complete reliability and proven performance in handling turbid liquids are required, there you will find Weinman Type "U" Centrifugal Pumps . . . the Class VB, ideal for dry-pit installation, driven by flexible extension shaft; the close-coupled Class VM, with low-level suction connection and high-mounted motor, or the column-suspended Class VS, for submerged service. In addition, the Class B and Class M are available when horizontal types are preferred . . . with motor, belt or close-coupled motor drives.

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WEINMAN

Apr. 20-22—Buffalo, N. Y. *(Statler Hotel)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand Street, White Plains, N. Y.

Apr. 27-30—Riverside, Calif. *(Mission Inn)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, J. C. Mallery, 4822 Dunsmore Ave., LaCrescenta, Calif.

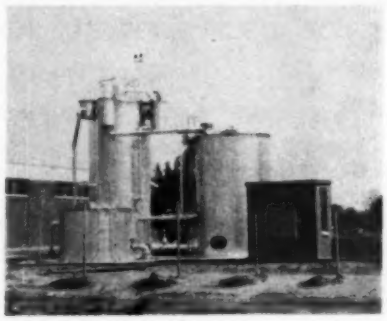
Apr. 29-30—Butte, Mont. *(Finlen Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Dept. of Health, Helena, Mont.

May 4-6—Pittsburgh, Pa. *(Hotel Webster Hall)*
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

May 19-21—Chenook, Wash. *(Yakima Hotel)*
PACIFIC NORTHWEST SECTION A.W.W.A. Sec'y, F. D. Jones, Room 305, City Hall, Spokane, Wash.

June 12-17—Chicago, Ill.
AMERICAN WATER WORKS ASSOCIATION. (75th Annual Convention). Exec.-Sec'y, Harry E. Jordan, 521 Fifth Avenue, New York 17, N. Y. (Reservations announcement by Nov. 1st.)

AN ALL STEEL Waste Treatment Plant



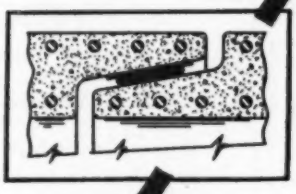
The tank at the left is a Spiragester, the tank to the right is a high rate filter, and the short tank in the foreground is a non-mechanized hoppered bottom final Spiraflo Clarifier. The plant handles the wastes from an ice cream manufacturing plant.

The new Spiragester Bulletin, No. 135, will be available the last part of October, 1954.

LAKESIDE ENGINEERING CORPORATION

222 West Adams Street • Chicago 6, Ill.

Specifies *LEAK-PROOF NON-DETERIORATING* TYLOX RUBBER PIPE JOINTS



TYPE "A" GASKET under full compression

* PROJECT — Richfield-Edina Trunk Sewers.

PIPE — 54" diameter reinforced concrete. Furnished by Twin City Concrete Pipe Co., Minneapolis, Minn.

ENGINEERS — For City of Minneapolis: Hugo G. Erickson, City Engineer. W. A. Ostrem, City Sewer Engineer.

CONTRACTOR — City of Minneapolis Engineering Department.

THE ONLY PERMANENTLY TIGHT LINES ARE LAID WITH TYLOX RUBBER GASKETS

TYLOX

★ PREVENTS INFILTRATION

★ DEFEATS CORROSION

★ REDUCES COST

OF NEW TRUNK SEWERS

Minneapolis city engineers and officials made sure taxpayers would get the most for their waste disposal dollars now, and in the future, when they designed the Richfield-Edina trunk sewer. One instance of wise planning was their choice of gaskets for coupling the large concrete sewer pipe. By specifying TYLOX Rubber Joints, they put the project **ahead** in three important ways.

MORE PIPE LAID PER DAY — Tylox eliminates "wet trench" delays . . . permits **immediate** backfilling . . . reduces job costs by cutting down man hours.

NO JOINT FAILURES — **Flexible** TYLOX compensates for angularities in the line . . . soil stresses or surface loads won't break the compression-tight, infiltration-proof seal.

NO CORROSION — TYLOX is virtually ageless. Sewage and industrial waste acids and alkalies can't harm it. Under ground and under compression, it outlasts the pipe itself.

Specify TYLOX, and make sure of fast-working, leak-proof, corrosion-proof joints on all **your** sewerage, drainage and non-pressure water lines. Write for more details and illustrated case histories today.

1913

HAMILTON KENT MANUFACTURING COMPANY

KENT, OHIO

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W & SW

Spillway

OVERFLOW FROM THE MAIN SECTION

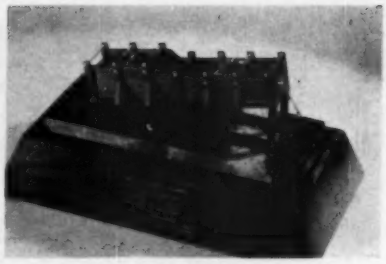
Dorr Honored by Veteran Staff on 50th Anniversary

DORR COMPANY VETERANS at the presentation:
J. D. Hitch, Jr., President; J. V. N. Dorr, founder and Chairman; and E. R. Ramsey, Vice-Chairman and ex-president.

Dr. John V. N. Dorr, founder and Chairman of The Dorr Company, was presented by 100 members of his veteran staff with a scale model of the first Dorr Classifier in celebration of the 50th Anniversary of its inception. Invented in 1904 to solve a milling problem at the Dorr, Lundberg and Wilson Mill in the Black Hills of South Dakota, it was the first of the three basic inventions upon which the company was founded.

The presentation was made before nearly 1000 staff members and their families and guests on August 23rd, at the Annual Picnic on The Dorr Company at their Westport Research and Testing Laboratories in Connecticut. J. D. Hitch, Jr., President, and E. R. Ramsey, Vice Chairman of the Board, made the presentation on behalf of the one hundred staff members with the longest tenure of service. Interestingly enough, 43 of these are on the staffs of the associated Dorr companies abroad.

Constructed on a scale of 5/8 inches to the foot, the model comprises a redwood tank and sterling silver hand operated raking mechanism. It is mounted on a polished pediment of gold ore from the famous Homestake mine. This slab in turn rests on a rectangular walnut base. On one side of the base an engraved plaque carries a brief commemoration of the presentation. A sliding drawer on the reverse side is inscribed with the names and dates of employment of the veteran associates presenting the gift.



THE FIRST DORR Classifier
An exact scale replica

In accepting the model, Dr. Dorr commented briefly on the circumstances surrounding the invention of the original Classifier, the vast worldwide growth of the company since that time, and his unlimited faith in the future.

Rangoon Water Supply Blasted 15 Times

Acording to press reports guerrillas recently blew up Rangoon's main water supply pipe 50 miles north of the city. This is the 15th time the pipe has been dynamited the last five years. Each time the capital of 750,000 inhabitants has become acutely short of water.

Low Cost Security

Today, more than ever it's important to protect persons against injury and property against damage. Get permanent low cost *security* and *control* with the better built Continental Chain Link Fence.

MADE OF KOPPEL STEEL

Continental Steel Corp.
Kokomo, Indiana

Please send FREE copy of "Planned Protection"—complete manual on property protection.

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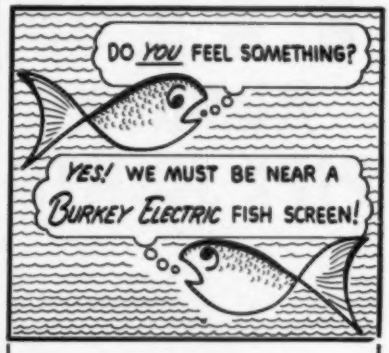


To prevent a deluge of fish from clogging your intakes during spawning runs and extremely cold weather, you need a Burkey Electric Fish Screen.

Electronic control equipment supplied by Westinghouse.

For free literature and quotations, write to:

Electric Fish Screen Co.
1130 No. Poinsettia Pl.
Hollywood 46, California

SPILLWAY

B-I-F Industries Fights Hurricane Carol and Contributes Chlorination Equipment

After the 1938 hurricane had sent river waters into its plant to a depth of 48 inches, B-I-F Industries, determined that it should not happen again, constructed and stored for future use a set of heavy duty storm doors. When, sixteen years later, Hurricane Carol mercilessly raked the Rhode Island area destroying and inundating countless properties, a handful of employees feverishly lugged and propped with sandbags the seldom-used barricades in a successful race against the onslaught of the billowing river.

When the winds had subsided and the waters had receded, it was discovered that the water rose to a depth of about 48 inches outside the plant. However, this time only eight inches of water seeped in and the plant resumed operations much sooner than neighboring industries.

The very next day after the hurricane, office personnel were on the job contacting all of New England's State Boards of Health offering free equipment for sterilizing the food and water supplies of stricken establishments and communities. Bonnet Shores, R. I., which suffered a break in its water main needed and sought chlorination equipment from the State Board of Health. Approximately two hours after it received a request from the State Board of Health for this equipment, Proportioneers, Inc., a division of B-I-F Industries, made available a specially-rigged, gasoline-driven Heavy Duty Midget Chlor-O-Feeder. The unit was used to sterilize the water supply of this hard-hit community until repairs brought operations back to normal.

Revised Digest of California's Sewerage Enabling Acts

Three years ago, the State Water Pollution Control Board published and distributed the Digest of Sewerage Enabling Acts of the State of California. Designed to aid individuals and communities in studying and solving their local waste disposal problems, this booklet was prepared to serve both as a guide and handy reference to the salient features of the 25 enabling acts relating to the formation and functioning of public bodies empowered to construct, operate, and finance sewerage facilities.

The Digest has now been revised to include legislative amendments enacted since 1951. In addition, the 1954 edition has been expanded to include (1) a condensed table comparing the various types of sewerage district by showing important components of each enabling act, (2) tables outlining the procedural steps to be taken in formation and financing of five types of district, and (3) a state-wide listing of six types of district that are now providing sewerage services.

Single copies of the revised Digest may be obtained gratis from the State Water Pollution Control Board, Room 610, 721 Capitol Avenue, Sacramento 14, California, or from any of the regional water pollution control boards. Additional copies may be purchased from the Documents Section, State Printing Division, 11th and O Streets, Sacramento 14, Calif.

The man who lives within his income lives without worry—and a lot of other things.

I LIKE A FOOLPROOF DESIGN— GIVE ME MATHEWS
AND DON'T FORGET YOU CAN REPLACE A BROKEN MATHEWS WITH A NEW BARREL IN A FEW MINUTES
MATHEWS ARE TOPS FOR EFFICIENCY IN SERVICE
FD

MATHEWS Means Dependable Hydrants

LONG LIFE. Mathews Hydrants have bronze parts at critical points—corrosion, rust and wear are thoroughly licked.

TROUBLE-FREE. The stuffing box plate, cast integral with the nozzle section, provides a positively leak-proof construction — water, sediment and ice cannot interfere with operating thread.

LOW-COST MAINTENANCE. Only one point requires lubrication—and that only during routine inspections.

REPLACEABILITY. A Mathews leveled in an accident can be replaced without excavating and in a jiffy. Community fire protection is interrupted only for a few minutes.

The Mathews includes every quality feature . . .

Compression type valve to prevent flooding • Head turns 360° simply by loosening bolts • Replaceable head • Nozzle sections easily changed • Nozzle level can be raised or lowered without excavation • Protection case of "Sand-Spun" cast iron for strength, toughness, elasticity • A modern barrel makes an old Mathews good as new • Mechanical-joint pipe connections as needed

MATHEWS HYDRANTS

Made by R. D. Wood Company

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of "Sand-Spun" Pipe (centrifugally cast in sand molds) and R. D. Wood Gate Valves

W&SW

New Equipment

High and Low Flow Alarm

1101

Brooks Rotameter Company, of Lansdale, Pa., has developed the FLO-GARD, a device designed to met the demand for a fail-safe, highly sensitive alarm device for Rotameters, Manometers and similar instruments in order to provide dependable operating stability.

According to the Company the unit offers an unequaled range of sensitivity for both high and low flow signalling and is the only alarm system available which can operate accurately in conjunction with spherical floats as small as 3/32", permitting use on smallest Rotameter capacity ranges. As a further indication of FLO-GARD sensitivity—it will detect one millimeter of float position change.

Fail-safe features insure that in the event of power failure, or failure of any electronic component, the load relay will drop out and operate the alarm contacts.

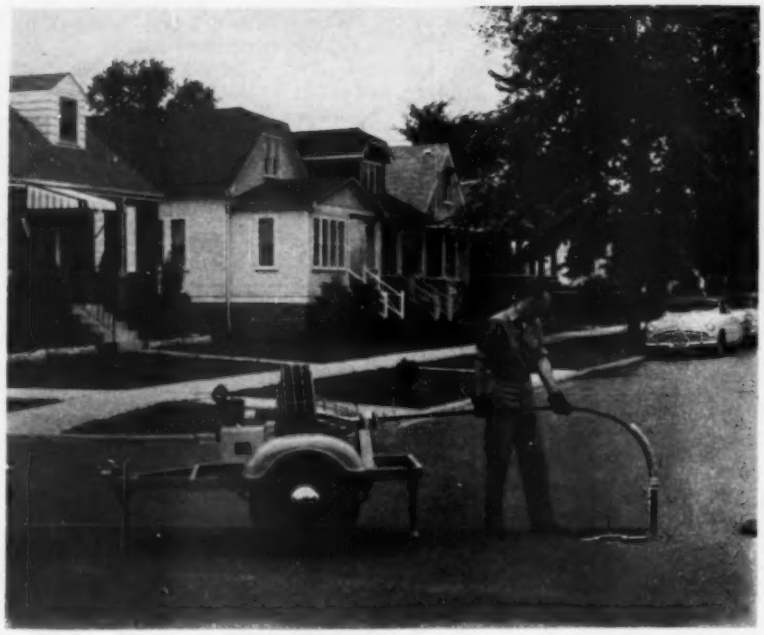
Two sensing coils may be connected in series to the same alarm unit and either installed on a single Rotameter to provide both high and low flow alarms—or installed on separate Rotameters.

Signals can also be provided for "return to normal" by special design of the Rotameter.

Tristand Pipe Vise

1102

The Ridge Tool Company, Elyria, Ohio, has announced the new Ridgid 40A Tristand Pipe Vise that has been made with an efficient new built-in folding tool tray that eliminates all loose parts. This stout tray pushes down flat for easy set-up and extra rigidity of vise stand; and pushes up easily to fold in and chain the legs for easy carrying to the job. New design full-size base overhangs front legs to give clearance for threader handles. Entire stand is extra light and rugged. Equipped with 3 pipe benders, ceiling brace screw, pipe rest and lots of tool hanging slots. Feet have rubber grommets to prevent travel in use. Two models: 40 Yoke Tristand, ⅛" to 2½" capacity; 45A Chain Vise, ¼" to 4".



O'Brien Sewerking Two Machines in One

1103

The O'Brien Manufacturing Co., Chicago, Illinois, has developed a sewer cleaning machine that uses heavy-duty flexible steel cable, as well as sectional steel rods, for cleaning sewer lines.

This new machine features the O-B Power Transmission making it possible to use flexible steel cable in long lengths. It is not only practical for regular main sewer line cleaning, but can also be used to go through traps and bends in practically all kinds of sewer cleaning work. The O-B Power Transmission does all the hard work in connection with sewer cleaning because, by means of power, the cables and cutting tools are not only turned into the sewer to do the cutting and cleaning, but when the work is done and the line is clean, the retriever can again be used to pull the cable back in the machine. The long cable length reduces the problem of connecting and disconnecting rods and is stronger and safer.

There is a saving in man power too because this machine can easily be operated by two men.

Reodorants for Odor Abatement

1104

Rhodia, Inc., New York, has announced the commercial availability of three new industrial reodorants specially designed for odor abatement in sewage systems, dumps, lagoons, and settling ponds.

The new reodorants, developed after years of laboratory tests and experimental use in municipalities, have proved successful in combating odors caused by decomposition products. They have been designated "Alamask" EK, "Alamask P4, and "Alamask" CPM.

Rhodia's newly-established engineering section will provide chemists and chemical engineers, who are experienced in waste treatment and malodorous problems, to give technical assistance to municipalities and industries and those engaged in waste disposal in their odor abatement efforts.

Newark, Ohio is no different from your city. You want the best pipe you can get for your water supply. So does Newark.

You want a line that meets every one of the "Big 3" requirements for an ideal water supply line: *long life, great strength* and *sustained high carrying capacity.* So does Newark.

That's why Newark picked Price Prestressed Pipe for its 16, 20 and 24 inch transmission and distribution lines . . . because Price Pipe gave them *all 3* of the "Big 3."

Miami, Louisville and Cleveland picked Price Pipe too . . . they wanted long life and protection from blow-ups, tuberculation and corrosion.

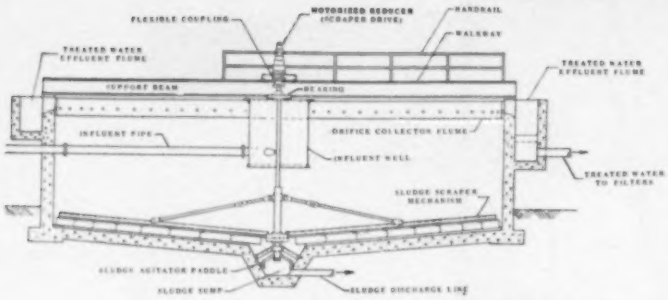
If *you* want this protection, put Price Concrete Pressure Pipe in your specifications.

Price Brothers Company

1830 East Monument Ave. • Dayton 1, Ohio

Concrete Pressure Pipe for Water Supply, Subaqueous, Pressure Sewer and Culvert Installations

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.



New Roto-Rake Sedimentation Basin

1105

Graver Water Conditioning Co., New York, has announced a new sedimentation basin for conventional municipal water treatment. Known as the Graver Roto-Rake Sedimentation Basin, the unit is most economical for the smaller community where a conventional water treatment and filtration plant is preferred. For lowest initial cost this equipment is constructed with a steel shell on a concrete bottom, but it can also be constructed of all concrete.

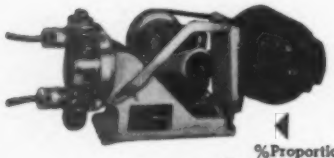
Square or round basins with water influent at the center are gaining in popularity because of proven hydraulic advantages. With this in mind, Graver developed the Roto-Rake sludge scraper; which rotates about an axis located at the center of the basin. This concentrates the sludge in a central sump from which it is removed by pump or hydrastatic pressure.

Graver lists among the Roto-Rake sludge scraper sedimentation basin's features these points: Equipment can be installed in existing basins; Equipment is vertically mounted for easy accessibility; Inclined blades on scraper continually move sludge to center pit; Central collection point for sludge; Uniform distribution of incoming water; Maximum horizontal water travel; and Decreasing velocity from water inlet at center of tank to outside collectors.

May we help?

Solving water problems is our business. Our engineering files contain over 40,000 case histories cross-indexed for easy reference. Whatever your problem — whether it involves sterilization, coagulation, pH control, taste and odor control, or water filtration %Proportioneers% has the experience and equipment "in stock" to solve it.

%Proportioneers% Model 47 Chem-O-Feeder — for hypochlorite, alum, soda ash, lime, ferric sulphate.



%Proportioneers% world famous "Little Red Pump" — the Heavy Duty Midget Chlor-O-Feeder. Simple, adaptable, dependable. Recommended for a wide range of water treating applications.

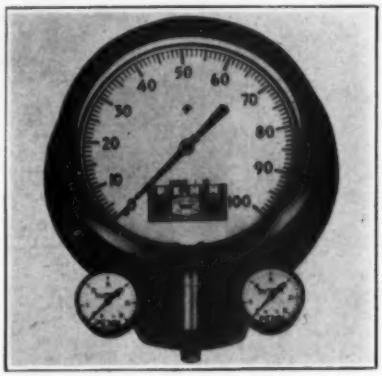
May we help? Send for data and recommendations to Proportioneers, Inc., 350 Harris Ave., Providence 1, R. I.

% PROPORTIONEERS

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • OMEGA MACHINE CO. • BUILDERS-PROVIDENCE, INC.

BIF METERS FEEDERS CONTROLS



Pressure Gage–Pneumatic Transmitter

1106

Penn Industrial Instrument Corp., Philadelphia, Pa., has announced a new Pressure Gage – Pneumatic Transmitter that combines the direct indicating features of a pressure gage with pneumatic transmission for remote indicating, recording or controlling of pressures.

The output pressure of the transmitter varies from 3-15 lbs. (or 5-25 lbs. if specified) regardless of the range of the pressure being measured. Ranges from vacuum to 10,000 psig are regularly available. Gages used are AA Grade, made in either 6" or 8½" sizes with bourdon tubes of a wide variety of materials such as bronze, beryllium copper, carbon steel, stainless steel, nickel or monel.

Highest accuracy is achieved as the instrument is calibrated with

comparison of actual pressure applied to the gage versus transmitted air. Process control is safely and efficiently achieved by using these pressure transmitters with pneumatic receiver controllers either of the full case recording type, miniature graphic panel type or non-indicating type.

Distances up to 1000 feet are practical for remote indication or recording; up to 400 feet for control.

New Portable Automatic Pipe Saw

1107

H. R. Prescott & Sons, Inc., Worcester, Mass., has introduced a portable automatic pipe saw for cast iron or steel pipe. It will cut 8" to 60" pipe. This precision saw is manufactured by the Fein Company of West Germany, and has been used in many countries throughout the world for the past 15 years.

The machine can be furnished with either pneumatic drive or electric motor. This unit weighs only 145 lbs. and can easily be installed on any size pipe by one or two unskilled men in approximately 5 minutes.

Only 12" clearance is required around the pipe to be cut. No pipe clamp or vise is necessary as the unit rotates only once around the pipe. Either pneumatic or electric machine will operate completely submerged in water.

The "Fein" pipe saw will cut 8" cast iron in 5 minutes, 16" in 11 minutes, 24" in 30 minutes.

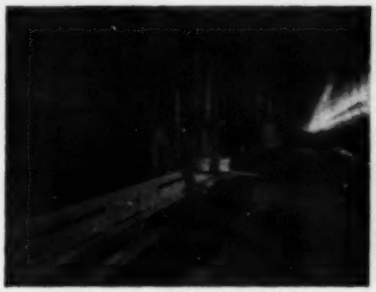
Hydraulic Front End Loader and Heavy Duty Backhoe Attachments

1108

Ottawa Steel Products, Inc., of Ottawa, Kansas, has announced the development and subsequent production of a heavy duty front end loader

Underneath the river!

THORITE Patching Mortar Crew at work in Air Tunnel under East River, New York.

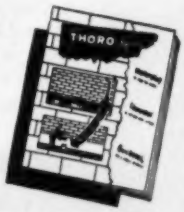


Sealing Leaks in Traffic Tunnel with WATERPLUG.

Sealing Drain Pipe Channels in Tunnel with WATERPLUG.

WATERPLUG Crew at work, before placing of tile lining, Battery Tunnels, East River, New York.

On many of the largest underground projects in the Americas and in foreign countries, WATERPLUG solves, for the contractor, his water problems. The job may be small or it may be large, the results are the same — Successful.



Get our 20-page brochure, pictorially describing, in detail, "How To Do It." It's yours for the asking. — No. 140.

Standard Dry Wall Products

BOX X, NEW EAGLE, PENNSYLVANIA

and heavy duty industrial style backhoe for combination use on rubber tired wheel tractors. The unique feature of the combination is the fact that one hydraulic system operates either machine.

The front end loader has 6000 pound capacity lift, and the backhoe can dig trenches up to 3 ft. wide and to over 9 ft. in depth. The front end loader mounts either ¾ or 1 yard buckets, or 1½ yd. snow bucket. It weighs approximately 2700 lbs. The heavy duty Backhoe weighs slightly under 3000 lbs. with the 36" bucket. Other bucket sizes are also available.

An outstanding feature of the loader is that only one control handle is necessary to control all actions of the loader bucket. Dual "One-Trol" control all actions of the various backhoe digging cylinders.

Speed-Grip Chuck

1109

The Ridge Tool Company, Elyria, Ohio, has announced that a new Speed-Grip Chuck that grips positively both forward and reverse, is a feature of the new RIDGID 500A Pipe and Bolt Threading Machine.

The manufacturer states that the Speed-Grip is not a conventional hammer-type chuck but uses a new gripping principle. Operation requires no specific effort—jaws are closed on work with a light sock of handwheel, and motor power further tightens the grip, released when desired by easy turn of handwheel. This Speed-Grip Chuck adds to the easy threading, cutting and reaming operations of the 500A. All tools can be used separately. Quick-opening Quadra, Dual and Mono die heads available; also bolt, conduit and special dies. Concealed oil system, lots of power, capacity ⅛" to 2" pipe or conduit, ¼" to 2" bolts. No. 500 pipe and bolt threading machines with lathe-type wrench chuck also available.

The World's Finest Pipe Cutters

for cast iron and Steel Pipe up to 60" dia.

Ideal for Water and Gas Works

Hundreds of Satisfied Customers

Fein Pneumatic Pipe Saw

Fein PORTABLE AUTOMATIC: cuts 8"-60" dia.

• Pneumatic or Electric Drive. • Weight: only 145 lbs. • Clearance: 12" max. around pipe. • Set up time: 5-10 min. by 1 or 2 unskilled men. • Pneumatic and electric machines operate under water. • Cuts 8" pipe in 5 min.—24" in 30 min. • Also available: "V" cutter for welded steel pipe.

Fein RECIPROCATING HAND SAW: cuts ½"-6" dia.

• Pneumatic or electric drive. • Weight: 16 lbs. • Cuts profiles and angles up to 45°. • Cuts 2½" steel pipe in 1½ min.—6" cast iron in 8 min.

Fein Electric Hand Saw

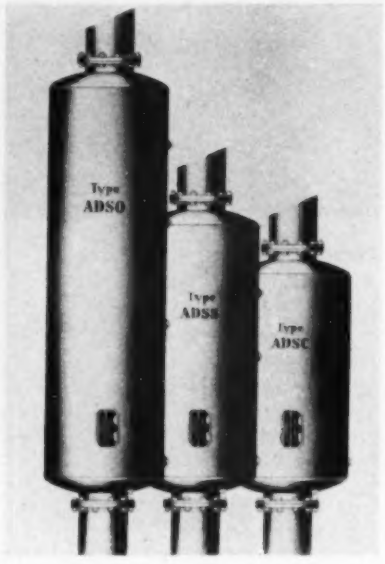
AMAZINGLY LOW COST. SIX MONTHS GUARANTEE

Write Drawer D

H. R. PRESCOTT & SONS, INC.

QUALITY WATER WORKS SUPPLIES SINCE 1914

BOX 7 — GREENDALE BRANCH — WORCESTER 6, MASS.
TELEPHONE WEST BOYLSTON 5-4431



Steam and Air Exhaust Silencers

1110

Burgess-Manning Co., Libertyville, Ill., has developed a new line of high velocity steam and air exhaust silencers, designed to set new standards in noise control in critical and non-critical areas.

The new line is known as Series "ADS" Acoustic Discharge Silencers. They are designed to eliminate high and low frequency noises caused by high velocity discharge from steam and air devices. The new silencers operate on the patented Burgess-Manning snubbing principle and employ especially designed acoustic reactance chambers plus special sound absorbing material.

The new silencers are for use on steam vents, steam safety valves, hogging jets, gas turbines, air nozzles, evacuating ejectors and similar devices discharging high velocity steam and air into the atmosphere.

"All water meters were alike to me until I saw the simple design and interchangeable features of American Meters"

"**Perhaps all water meters** seem alike to you, too. If so, take a minute and look inside an AMERICAN METER. You'll discover the simplest design and the most complete interchangeability of parts you've ever seen.

These features, plus a competitive price, sold us on AMERICAN METERS. They're standard with us now . . . and saving us time and money, too!"

For the full story on AMERICAN METERS, write today.

BUFFALO METER CO.

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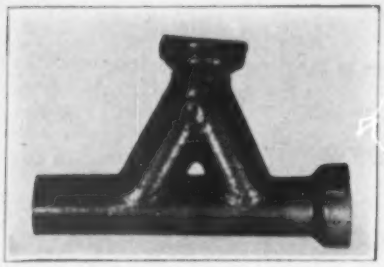


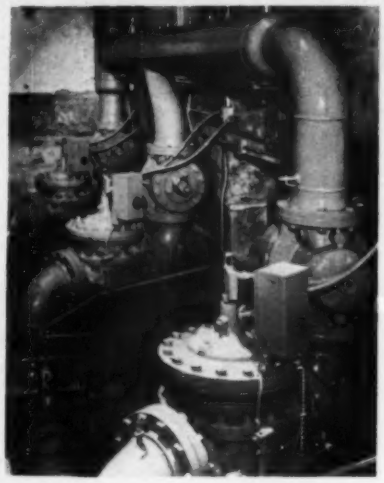
Two-Way Clean-Out Fitting For Clay Pipe

1111

Cannelton Sewer Pipe Co. of Cannelton, Ind., has developed a Two-Way Clean-Out fitting, of Vitrified Clay Pipe.

This Two-Way Clean-Out is the first fitting for building sewers, which makes possible a permanent clean-out station in the homeowner's yard—thus eliminating the necessity of digging out a sewer line when a stoppage occurs.

Once the Two-Way Clean-Out is installed in a sewer, it allows the line to be cleaned in either direction without taking out a length of the pipe. The line can be cleaned merely by inserting a cleaning rod in either direction through the Two-Way Clean-Out. Is available in 4-and 6-inch sizes.



Automatic Control Valve Provides Smoother Pump Performance

1112

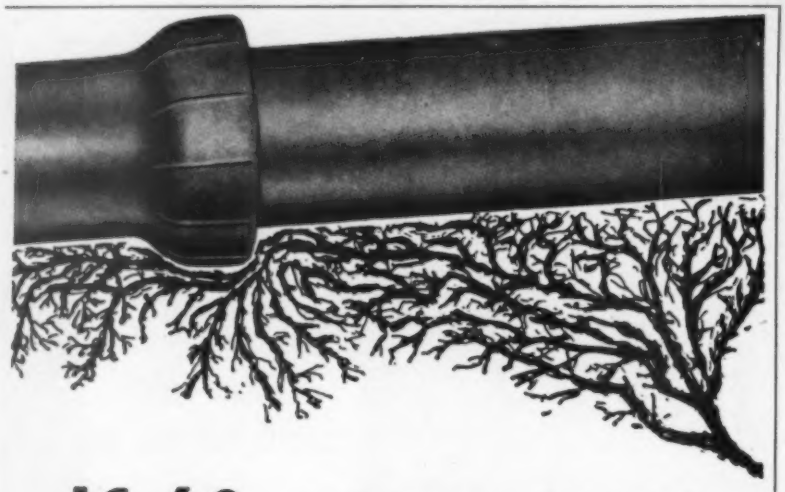
Cla-Val Co., Alhambra, Calif., has announced that a new kind of booster pump performance without the starting stopping surges usually experienced is now possible as a result of an improved Cla-Val pump control valve. When installed in the line, the valve automatically prevents surges because it causes the pump to be started and stopped against a closed valve.

Fully automatic, the pump control valve is a modified globe-type design, operated by a diaphragm, and controlled by a four-way solenoid valve. A micro-switch assembly actuated by the valve stem serves as an electrical interlock on the pump motor starting switch.

Once the pump has been started, the valve gradually opens allowing line pressure to increase slowly until a full pumping head is reached. In stopping the pump, the valve gradually closes, reducing the flow. When the valve is completely closed the pump stops automatically. Thus, the pump is controlled more accurately than is possible with manual operation.

Adjustable opening and closing rate is made possible by flow control valves located in the control lines. Line pressure is used for operation, hence no outside pressure supply is required.

In addition to this valve, Cla-Val Co. also manufactures a control valve of similar design for deep-well pumps. Unlike the booster pump control valve, this valve is installed on a tee at the discharge of the deep-well pump. The principal difference is that this unit permits the release of the first rush of air and water to be discharged to atmosphere.



JC-60 SEWER JOINTS

. . . actually turn roots away

An ordinary root may exert pressure as high as 50 psi at the tip. Thus, it is easy to understand why roots are a common cause of sewer line destruction . . . and why foresighted engineers specify ATLAS JC-60®, the synthetic plastic base, *root resistant* jointing compound.

Roots cannot penetrate the surface of a JC-60 joint. JC-60 is hard . . . so hard it forces roots to change direction. At the same time, *high adhesion of JC-60 prevents roots from entering between the pipe and the compound.* Even at maximum pressure, ordinary roots cannot break the tight bond that JC-60 provides at the joint interfaces.

Furthermore, JC-60 *retains* this combination of characteristics. Even after hours of overheating in the melting pot or pouring under adverse conditions, properly poured ATLAS JC-60 still provides tight, root-proof joints that withstand normal settling without failure . . . reduce infiltration and exfiltration to a minimum . . . resist chemical and bacterial attack.

FOR COMPLETE FACTS . . . Send for Bulletin M20-3.

ATLAS JOINTING COMPOUNDS
. . . a permanent bond

OTHER ATLAS PIPE JOINTING MATERIALS *include* GK® *and* SLIPJOINT GK® *for sewers . . .* MINERALEAD® *and* HYDRORINGS® *for cast iron water pipe.*

ATLAS MINERAL PRODUCTS COMPANY
MERTZTOWN, PENNSYLVANIA

Engineering Representatives Throughout the United States

EVERYONE IS PLEASED WITH THEIR *Flexible* SEWERODER AT WILLIAMSPORT, PA.

Taxpayers and workers alike are complimenting the Williamsport Sanitary Authority for having had the good judgment to buy a "Flexible" SeweRodeR. This is the mechanical rodding marvel that eliminates 9/10th of the usual hard labor in a day's work. It will clean 50 blocks of sewers per week at a cost of less than 3c a foot including labor, maintenance and parts replacement.

Recently Williamsport had a 2.9 inch rainfall which caused the sewers to stop up. The SeweRodeR did the "opening" job so fast the citizens are saying, "Now we are getting some real service!" The Authority found the sewers filled up with roots—indicating that in the past the lines had merely been opened—not cleaned.

Pointing to the machine is Mr. Kenneth Glenz, mgr. of the Authority. Standing next is Frank Heller, Sect'y. The fine crew, left to right, is Walter Kuna, Foreman, Lawrence Gephart, operator and Victor Andy.

FREE DEMONSTRATION INVITED

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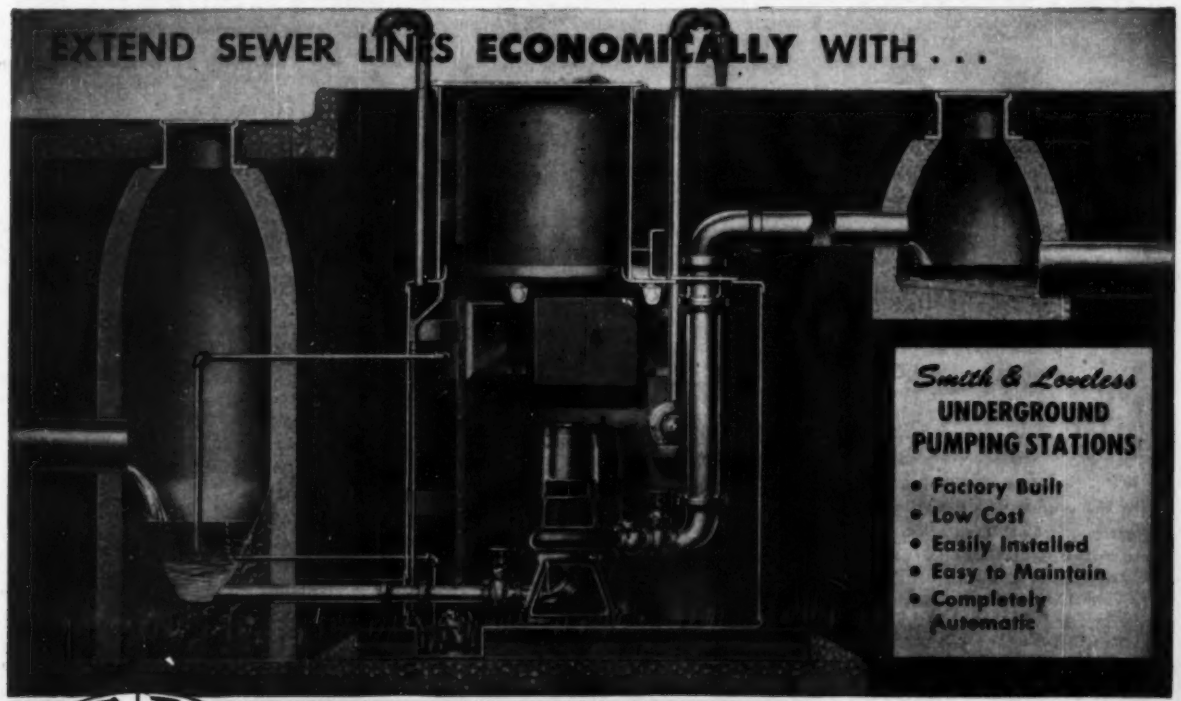
Flexible **SALES CORPORATION**

3786 Durango Ave., Los Angeles 34, Calif.

(DISTRIBUTORS IN PRINCIPAL CITIES)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

EXTEND SEWER LINES ECONOMICALLY WITH . . .



Smith & Loveless
UNDERGROUND PUMPING STATIONS

- Factory Built
- Low Cost
- Easily Installed
- Easy to Maintain
- Completely Automatic

S&L *Smith & Loveless, Inc.*

Write for your free copy of our Engineering Data Manual, containing full details on Smith & Loveless Pumping stations.

P. O. BOX 8172, KANSAS CITY, MO., Plant, MERRIAM, KANSAS

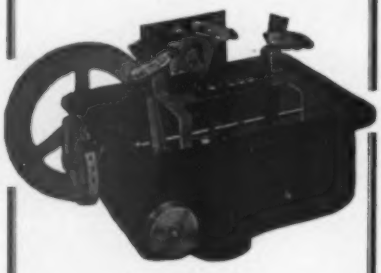
General Filter Appoints Two Engineers to Staff

General Filter Company, Ames, Iowa, has announced that Keith E. Demorest and Conrad E. Lawlor have recently joined the staff.

Demorest, a native of Omaha, Nebraska, is a specialist in the layout and design of water treating equipment. He holds a B.A. degree from Omaha University where he majored in physics and was graduated in 1952. His engineering background includes a year and a half in the engineering department of the Union Pacific Railroad and two years of patent work.

Lawlor, a native of Ames, is an industrial sales engineer for the state of Iowa handling sales of industrial water treatment plants and water treating equipment for swimming pools. Lawlor joined the General Filter Company upon his discharge from the Navy.

ROTO-TROL



RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

Write for full data

WATER LEVEL CONTROLS DIVISION

HEALY-RUFF COMPANY

783 HAMPDEN AVE., ST. PAUL 4, MINN.

Brooks Products Appoints Sterling To Oakland Branch

Brooks Products Inc., Pasadena, Calif., has announced the appointment of E. C. Sterling Jr. as manager of the firm's Oakland factory, located at 2400 Adeline Street. "Ed", a graduate in economics from Pomona College and an Oakland resident, most recently served as Western Division Sales Manager for Townsend Co. before joining the Brooks organization.

The company also announced that C. C. McGonegal, who has been with Brooks Products for several years, has been named District Sales Representative and will devote full time to selling activities in Northern California, Oregon and Washington.

Smith Appointed by Food Machinery

Food Machinery & Chemical Corporation, New York, has announced that Arthur F. Smith has been appointed Manager of Sales, and Preston F. Tinsley, Assistant Manager of Sales Westvaco Chlor-Alkali Division.

Westvaco Chlor-Alkali Division will henceforth sell the Chlorine, Caustic Soda, Caustic Potash, Soda Ash, Carbon Bisulphide, Carbon Tetrachloride and Grain Fumigants manufactured at its South Charleston, W. Va., and Westvaco, Wyoming, plants. These chemicals were previously sold for it by Westvaco Chemical Division which has now been inactivated.

De Laval Appoints Ass't. Controller

The De Laval Steam Turbine Co., Trenton, N. J., has announced the appointment of Beverly Houston as Assistant Controller. He has been associated with De Laval for many years in the accounting department.

Mr. Houston attended the Wharton School, University of Pennsylvania, and Rider College. He is a director of the Trenton Chapter, National Association of Cost Accountants and the Trenton Chamber of Commerce.

Permutit Appoints New District Manager

The Permutit Company, New York, N. Y., has announced that Lee W. Hanson has been appointed to the position of District Sales Manager for Texas by the Household Sales Department.

Mr. Hanson will be responsible for the sales and service of Permutit's extensive line of household water conditioning equipment and resins in the Texas area. His duties will involve franchise selling, distributor and dealer sales training and directing distributor and dealer sales programs. His office is located at 2408 Windsor Lane, Pasadena, Texas.

Permutit's new District Manager is well qualified for his duties, having been District Sales Supervisor for the Shell Oil Company for a period of over eight years and with A. O. Smith Corporation for 18 months.

ANTHRAFILT

Trade Mark Reg. U. S. Patent Office

A Filter Medium For All Purposes

ANTHRACITE EQUIPMENT CORP.

Anthracite Institute Building
Wilkes-Barre, Pa.

All correspondence regarding sales and engineering should be addressed to:

PALMER FILTER EQUIPMENT CO.

822 E. 8th St. Erie, Pa.

Engineers and Sales Agents

Sales Engineer

Calling on water works and sewage disposal plants to sell special cements and compounds for acid proofing, pipe jointing, etc. Company in business over 50 years. Commission basis. Leads furnished. No objection to a few non-competitive lines. Send complete history and references to: SAUEREISEN CEMENTS CO., Pittsburgh 15, Pa.

Le Roi Organizes Municipal Sales Department

Le Roi Company, Milwaukee, Wis., has announced the organization of a Municipal Sales Department. Named to head the new department is Guy Scrivner, who served the company as sales engineer for the past two years throughout the Midwest.

Scrivner will be responsible for the sale of engines for use chiefly to drive standby generator sets and power centrifugal pumps. Most of the resulting new activity will come from municipalities.

A 1945 engineering graduate of Northwestern University, Scrivner joined Le Roi in 1946. After engine lab work and experience in the catalog department he was named advertising manager in 1948. He served in that position for four years.

The new department will coordinate a nationwide sales effort from headquarters in Milwaukee.

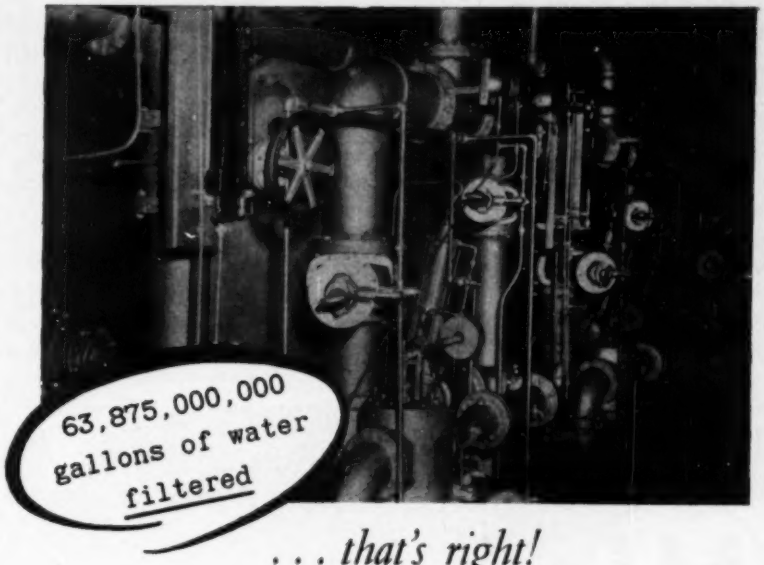
Curtis Appointed V. P. Of United Concrete Pipe

United Concrete Pipe Corporation, Baldwin Park, California, has announced that George L. Curtis, Chief Engineer, has been appointed Vice-President, Engineering.

Mr. Curtis became associated with the firm in 1946 after his war-time service in the Civil Engineering Corps, U. S. Navy. Prior to the war, his experience included work with construction firms and engineering organizations in New York and New Jersey. He is a graduate of Newark College of Engineering in New Jersey, a member of the American Society of Civil Engineering, and a registered Civil Engineer in both California and New York.

Pittsburgh Coke Opens Office in Dallas

Protective Coatings Division, Pittsburgh Coke & Chemical Company, Pittsburgh, Pa., has announced that a new divisional sales office has been opened in Dallas, Texas. Mr. O. E. McCullough, Jr., has been appointed



. . . that's right!

THIS AMERICAN FILTER PLANT HAS BEEN IN OPERATION 25 YEARS

. . . without replacing a single filter bed!

Largest pressure filter in the world in continuous operation since installation

Twenty-six horizontal units, 8′ x 20′, were installed by American twenty-five years ago at the United Piece Die Works, Lodi, N. J. They have been operating every day, 24 hours a day, since then, handling 7 million gallons daily from the muddy Saddle River.

Not one filter bed has had to be replaced

Here is proof of an American design feature—an adequate underdrain system for uniform collection of filtered water and proper distribution of back wash water. American Pressure Filters are designed and built to out-perform all others. Available in both vertical and horizontal types in a wide range of sizes.

Call or write today for further information.

SERVICE SINCE 1902 TO THE INDUSTRY

AMERICAN *Water Softener* **COMPANY**
INCORPORATED

FOURTH AND LEHIGH AVENUE • PHILADELPHIA 33, PENNSYLVANIA

DEAERATORS • HOT PROCESS SOFTENERS • REACTORS • FILTERS • ZEOLITE SOFTENERS • CHLORIDE DEIONALIZERS • AERATORS & DEGASIFIERS
HYDROGEN SODIUM ZEOLITE SOFTENERS • DEMINERALIZERS • CHEMICAL FEEDERS • CONTINUOUS BLOWDOWN • SWIMMING POOL EQUIPMENT

to this office in charge of cold coating sales.

Before being recalled into flying service with the Marines, Mr. McCullough had been attached to the Pittsburgh office. He is a native of Dallas, where he had his own oil business. Prior to that he had been Director of Personnel and Sales Manager of Stacey Dresser Engineering Company in Cleveland, Ohio.

He studied geology at SMU and served as captain and later major in the U. S. Marine Air Corps.

Newly Formed Company Rubber Lines Tanks

Merlin H. Anderson, Ames, Iowa, was recently named president of a newly organized company in Ames, Iowa, known as "Tank Linings Incorporated." Tank Linings, Incorporated has the complete facilities for lining tanks and is the exclusive licensed applicator of Koroseal in the Iowa area. Koroseal is the trade name for a strong flexible lining material for tanks, developed by the Goodrich Rubber Company.

According to Anderson, Koroseal is a tough, long lived, abrasion-resisting material which is not affected by most acids and has high resistance to strong corrosives. It can be bonded to steel, wood or concrete and is recommended for many uses for which rubber is not suitable.

Other officers of the company are, F. R. Kenny, Vice President, and A. G. Schreiber, Secretary - Treasurer. The offices are located at 923 Second Street, Ames, Iowa.

You can save in valve costs if your operating conditions permit installation of M & H Class A or B Gate Valves for low pressure service. These valves are lighter in construction than M & H Class C valves. In case of large valves installed in an elevated position, these lighter weight low-pressure valves may save you additional trouble and expense because you can use lighter supports.

The design, materials and workmanship are exactly the same as Class C valves. The only difference is the lighter weight body, bonnet and other parts of the Class A and B valves.

Class A is for 50 lbs. working pressure and receives 100 lbs. hydrostatic test. Class B is for 100 lbs. working pressure and receives 200 lbs. hydrostatic test. Furnished with non-rising stem, outside screw and yoke, or with sliding stem including hydraulic or electric motor operation. For further details, wire or write M & H VALVE AND FITTINGS COMPANY, ANNISTON, ALABAMA.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Mathews Rejoins Neptune

Neptune Meter Co., New York, N. Y., has announced that M. A. (Gus) Mathews, sales engineer in Texas, has returned to his office in Aransas Pass, after a two-year tour of duty in the Marine Corps.

Mr. Mathews was recalled to active duty in March 1952 with the rank of major to the Second Engineer Battalion, the combat engineers for the Second Marine Division, Fleet Marine Force. After serving as a training and operations control officer at Camp LeJeune, N. C., he was assigned to the Puerto Rico area and took part in large scale amphibious exercises in the Caribbean area.

Mr. Mathews joined Neptune in 1949 in the Dallas office after having been with the Houston Water Department as assistant sanitary engineer. He entered the water department in 1941 as a chemist after graduating from Sam Houston State College in 1939 and two years of teaching school at LaMarque, Texas.

Sterling Electric Promotes Bedell

Sterling Electric Motors, Inc., Los Angeles, has announced that Richard L. Bedell has been appointed Branch Manager of the Rochester, New York, office.

Mr. Bedell was educated at Syracuse University and majored in marketing. He has had varied experience in the New York and New England area as a Sales Engineer for distributors of electrical apparatus. Mr. Bedell was formerly an Application Engineer in the New York office serving the Hudson River Valley area.

Everett Appointed Exec. V. P. Of Beaver Pipe Tools

Beaver Pipe Tools, Inc., Warren, Ohio, has announced the appointment of Mr. Charles T. Everett as Executive Vice President and General Manager, to succeed Mr. W. A. Phillis, President, who will retire in the near future.

Mr. Everett was formerly associated with the Aviation Division of Bingham-Herbrand Company, Fremont, Ohio, as Vice President and General Manager. He is a graduate of the University of Cincinnati, with the degree of Mechanical Engineer. In World War II, he served over five years with the Ordnance Department, attaining the rank of Major.

Weatherly Elected Director Of Hagan Corporation

Hagan Corporation, Pittsburgh, Pa., has announced that Robert S. Weatherly, of Birmingham, Alabama, was elected a director of Hagan Corporation and its subsidiaries, Hall Laboratories, Inc., Calgon, Inc., and The Buromin Company.

Mr. Weatherly was named at a recent meeting of the Hagan Board of Directors. He fills one of two vacancies authorized by company shareholders at their April 19 meeting when they increased the number of directorships from 10 to 12. The increase was authorized for the purpose of gaining participation in company management of men not presently employed by the corporation.

A management consultant in Birmingham since 1952, Mr. Weatherly was general sales manager for the Monsanto Chemical Co., St. Louis, Mo., from 1939 to 1952. Prior to that he was vice president of the Swann Chemical Co., Birmingham. He is a member of the Chemists' Club, New York City, and a graduate of the University of Alabama, class of 1920. He also attended the Harvard University Graduate School of Business Administration.

Gustin-Bacon Appoints Two District Managers

Gustin-Bacon Manufacturing Company, Kansas City, has announced the appointment of two new district managers: C. Weston Goode, southeastern United States; and H. J. Smith, Kansas City sales division.

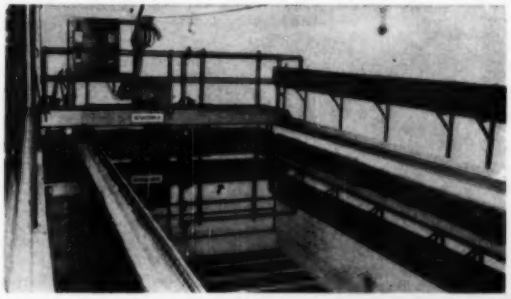
Mr. Goode, Atlanta sales representative for Gustin-Bacon since 1944, is in charge of the newly opened district office at 2025 Peachtree Road, N. E. Atlanta.

Mr. Smith has been with the company since 1949 as representative in Louisville and St. Louis. In his new position, he will direct sales in Colorado, Wyoming, Nebraska, Kansas, Oklahoma, Arkansas, Texas Panhandle, southern Illinois, western Tennessee and northern Mississippi.

H. J. Corson Joins Pittsburgh Coke

Pittsburgh Coke & Chemical Company, Pittsburgh, Pa., has announced the appointment of Mr. H. J. Corson of the sales staff of the Protective Coatings Division. Mr. Corson has been assigned to the division's New York office.

AUTOMATIC BACKWASH SAND FILTERS

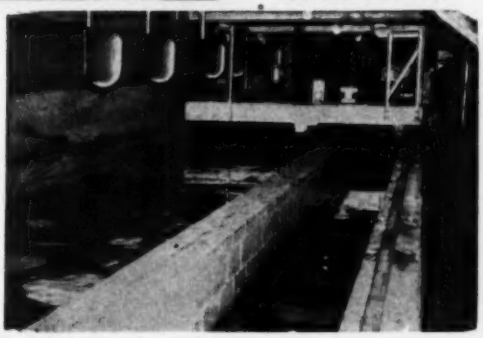


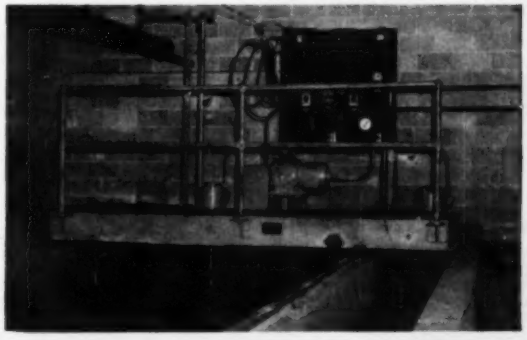
for WATER SUPPLY

12½' x 40' Hardinge Automatic Backwash Sand Filter in a Vermont municipal water-treating plant. It cleans its own filter bed automatically. Highly efficient.

for TRADE WASTES

6' x 52' Hardinge Filter handling "white water" in a Canadian paper plant. No shut-down or change-over necessary for back-washing.





for SEWAGE

9' x 28' Hardinge' ABW Sand Filter operating on sewage settling tank effluent at a sewage disposal plant in British Columbia. It runs indefinitely with very little attention.

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

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NEW PROCESS
Cleans
Filtration
Beds
Chemically!

Consulting engineers, waste and sewage works operators, departments of health, municipal engineers and others will be interested in this development by Solvent Service Inc.

The *process safely removes gelatinous sludge and industrial waste deposits *thoroughly* and *uniformly* through the depth of the bed.

No digging is required and all ponding and pooling is eliminated.

Test results are demonstrated in a 16 mm color film which we'll be glad to show you without obligation. Just drop us a note, indicating the size of your filtration bed.

**Patent applied for.*

SOLVENT
service inc.
242 Latimore Street
Painesville, Ohio
Phone: Elmwood 22101

Mr. Corson will be primarily engaged in serving architectural and engineering companies in the area with technical data and specification assistance on the utilization of the company's complete line of Pitt Chem tar base maintenance coatings.

Prior to joining Pittsburgh Coke & Chemical Company, Mr. Corson was associated with the Columbia Steel & Brass Corporation and prior to that with the Johns Manville Corporation. He is a graduate of New York University.

Goldak Appoints Kaufman

The Goldak Company, 1544 W. Glenoaks Blvd., Glendale 1, California, has announced the appointment of Edwin M. Kaufman as Chief Engineer in Charge of Research and Production.

Since 1939, when he first joined the Douglas Aircraft Company, Santa Monica, California, in their electrical research department, he served as a staff member (Electronic Specialist) for the University of California Scientific Laboratory at Los Alamos, New Mexico. The Goldak Company, one of the largest producers in the electronic locator field, is expanding their operation and productive capacity under the direct supervision of Mr. Kaufman.

Armco to Build New Plant

Armco Drainage & Metal Products, Inc., Middletown, Ohio, a subsidiary of Armco Steel Corporation, will begin construction soon on a new steel fabricating plant near Tempe, Arizona.

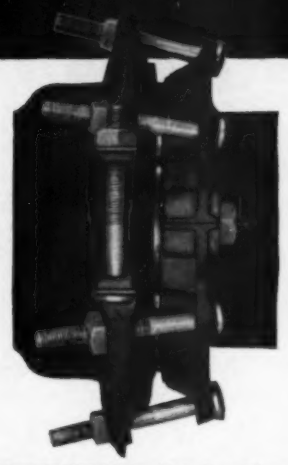
The new plant will employ about fifteen people and will turn out corrugated metal drainage pipe in a wide variety of diameters and lengths. When completed, the plant will be the 48th in the chain of similar plants which Armco Drainage operates throughout the U. S. and Canada.

The plant will be located on a 10-acre tract and is expected to cost approximately $100,000. Also located at the plant site will be an office building housing the area sales offices of both Armco Drainage and the Sheffield Division of Armco Steel Corporation.

Universal Concrete Pipe Moves New York Office

Universal Concrete Pipe Company, Columbus, Ohio, has announced that the company's Eastern Sales Office has been moved from the Graybar Building, New

REPAIR BELL AND SPIGOT JOINT LEAKS



SKINNER-SEAL Bell Joint Clamp. Gasket is completely sealed. 2" to 42" incl. Write for catalog.

M. B. SKINNER COMPANY
SOUTH BEND, INDIANA

the search for
PURE WATER
354 B.C.
"Hippocrates' sleeve" (a cloth straining bag) was a popular water treatment method in the 4th Century B.C.

For excellence in MODERN water treatment equipment —gravity and pressure filters— recirculation apparatus...

MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

ROBERTS FILTER
MANUFACTURING CO.
607 COLUMBIA AVE., DARBY, PA.

York City, to the plant, located at 85 Harbor Road, Port Washington, Long Island, New York.

The telephone number will remain the same, and the mailing address is Post Office Box 728, Port Washington, New York.

Niagara Filters Announces Sales Appointments

Niagara Filters Division of American Machine and Metals, Inc., East Moline, Illinois, has announced several sales appointments.

John A. Meursinge, Los Angeles, Calif., and Allan Edwards, Inc., Tulsa, Okla., have been appointed sales representatives. James J. McHugh has been appointed sales representative for Niagara Filters Division and Tolhurst Centrifugals Division, replacing Hardy Bach, who resigned.

John A. Meursinge will represent Niagara in Arizona, Nevada, and all of southern California, except for the breweries in southern California. Sales headquarters are located at 416 West 8th Street, Los Angeles. C. T. White, Niagara's agent in northern California will call on breweries in southern California, in addition to his previous sales activities.

Allan Edwards, Inc., will represent Niagara in Oklahoma, Arkansas, western Kansas and northern Texas. Sales headquarters are located at 2445 South Jackson, Tulsa.

Mr. McHugh's territory will include Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island and up-state New York, and he will make his headquarters at 233 Broadway, New York City.

Before joining American Machine and Metals, Inc., Mr. McHugh was a sales engineer for National Acoustics Company.

Sterling Appoints Zobel District Manager

Sterling Electric Motors, Inc., Los Angeles, Calif., has announced the appointment of Richard J. Zobel as Philadelphia District Manager. Mr. Zobel had previously been serving the Philadelphia area as an Application Engineer.

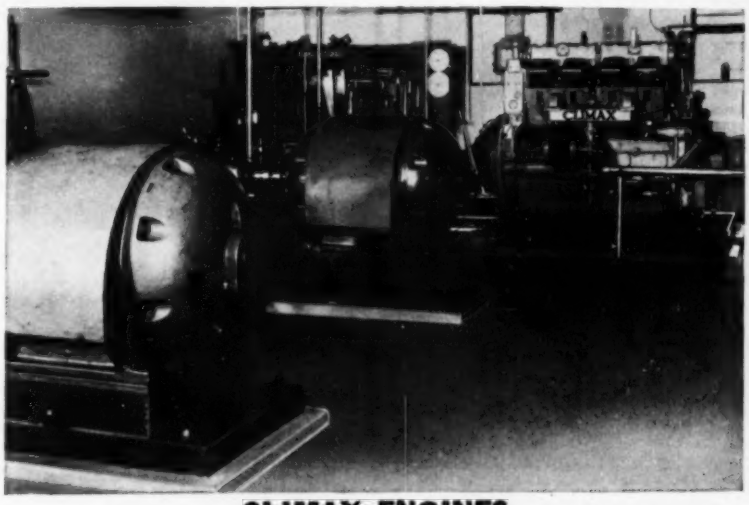
A native of Michigan, Mr. Zobel graduated from Michigan State College in the school of business administration. Mr. Zobel sold industrially in Eastern Pennsylvania with the International Harvester Company in industrial stationary sales.

Kenco Promotes Cowan

Kenco Incorporated, Lorain, Ohio, has announced that Joseph H. Cowan has been promoted to sales manager.

Mr. Cowan joined the Kenco sales department in March of 1951. He was recalled to active naval duty in November of 1951, returning to Kenco in December of 1953, to resume his sales activities. Cowan attended Colgate University, graduating in 1948 with an A. B. degree.

As sales manager, Mr. Cowan will head up all activities relating to sales, advertising and sales promotion. His acquaintance with Kenco jobbers and distributors, plus extensive field work in submersible pump applications and market development, offers a unique service for Kenco customers.



CLIMAX ENGINES

PROTECT COLORADO SPRINGS WATER SUPPLY

Bringing water over a mountain makes Colorado Springs' problem differ from some, but as in many other cities, uninterrupted service is insured by the installation of Climax standby engines.

Lifting water approximately 1600 ft. through 16 miles of pipe, in 800 ft. stages, the two pumping stations each include two 2 MGD electric motor-driven pumps and a 1 MGD Climax engine-driven pump.

Pictured is one of the Climax model V-85 propane burning engines direct connected to a 700 GPM centrifugal pump requiring 192 H.P. at 1200 RPM.

Project designed by and constructed under the supervision of Black & Veatch, Consulting Engineers, Kansas City, Missouri.

climax

FOR COMPLETE INFORMATION, WRITE TO . . .

ENGINE AND PUMP MFG. CO.

208 So. La Salle St.

CHICAGO 4, ILLINOIS

Factory—Clinton, Ia. *District Office*—Dallas, Tex.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

EDDY valves

for

- Extensions and New Installations
- Installation of New Valves in existing lines
- Replacement of worn-out valves
- Shut-off Valves for hydrants

because

- Taper seats provide positive, self-wedging action assuring no-leak closing.
- Only 3 moving parts.
- Even new employees without special training can service and maintain an Eddy Valve.
- Available with standard or "O"-Ring packing.
- Furnished with bell, flange or mechanical joint connections to fit any existing or planned installation.
- 104 years of successful operations assure availability of repair parts.
- Conform to all A.W.W.A. specifications.

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons
WATERFORD, NEW YORK

W&SW

Earthworm Boring Machine

1113

Lube Jack Company, Santa Monica, Calif., has available a 4-page folder on the **Earthworm Boring Machine.**

The Earthworm is described as a portable compact unit for underground installation of pipe and conduit. In addition to giving general operation instructions, the folder gives suggested procedures for installing pipe or conduit in 10 foot lengths and for installing wrapped or iron pipe in 20 to 150 foot lengths. The last page of the folder discusses the design and operation of the various boring bits available with the machines and makes recommendations for the proper bit according to the condition of the soil.

A price list of the machines is also included in the folder.

Sewer and Drain Machines

1114

Kollmann Manufacturing Co., Erie, Penna., has available a 12-page folder on **Kollmann Sewer and Drain Machines.**

The folder discusses the features, specifications and accessories for the complete line of machines. Photographs are shown for each model and line drawings illustrate the machines in operation. A complete line of power units are also included.

Water Hammer Data Book

1115

Wade Manufacturing Company, Elgin, Illinois, has just published a **Water Hammer Engineering Data Book.**

This attractive 24-page book printed in 3-colors provides a definitive treatise on the cure and prevention of water hammer at the design level. It defines water hammer, describes the Wade Shokstop and gives details on how to cure or prevent water hammer.

An important feature is the fold-cut, sizing procedure chart which enables any architect or mechanical engineer to size the Shokstop required to prevent any water hammer problem long before the building is erected.

Chemical Pumps

1116

Goulds Pumps, Inc., Seneca Falls, N. Y., has just issued an 8-page bulletin covering its new line of **Centrifugal Pumps.** These pumps were developed to provide dependable pumping of acids, alkaline liquors, slurries and other process liquids.

This bulletin describes construction details, outlines specifications, charts the interchangeability of parts, and shows performance curves of the nine sizes in which these pumps are manufactured. It also lists the various materials of construction in which the pumps are available.

Versatile Sewer Structures

1117

Armco Drainage & Metal Products, Inc., Middletown, Ohio, has just published a bulletin that gives the **Four Important Requirements for Sewers**—easy handling, fast assembly, long life, and installed economy.

The theme of the bulletin is that all sewer problems are different. They may involve as many as eleven considerations. How, where and when to choose the right type of sewer structure for the right purpose frequently puzzles city officials, engineers and contractors. This bulletin should help them.

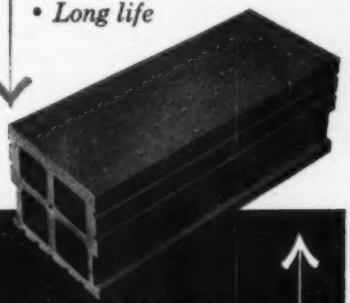
Gravity Filters

1118

The Permutit Company, New York, N. Y., has just prepared a comprehensive and well illustrated 24-page bulletin on **Permutit Gravity Filters** that supersedes a bulletin issued in 1952. Of interest to all engineers dealing with water problems, it shows a complete line of gravity filters and filter accessories—manually operated, semi-automatic and automatic—including operating tables, rate of flow controllers and gauges.

Specifications, operating instructions and characteristics, outline dimensions and typical installation photographs have been included in this new edition.

• *Permanence*
• *No tuberculation*
• *Equal distribution*
• *Uniform filtration*
• *Low loss of head*
• *Acid, alkali-resistant*
• *Long life*



You get ALL these advantages with

LEOPOLD

Glazed Fire Clay

TILE FILTER BOTTOMS

Today, in more than 250 plants with a daily capacity of over 1¼ billion gallons, Leopold Duplex Filter Bottoms are providing dependable, economical service with minimum maintenance.

Made of highest quality de-aired fire clay—vitrified and salt glazed, the Leopold Filter Bottom requires only a shallow depth of small sized, inexpensive filter gravel to support the filtering medium. Further, the laterals and distributing blocks are all combined in one strong permanent unit that will last indefinitely.

Adaptable to any rectangular filter unit, the Leopold Glazed Tile Filter Bottom is designed to successfully meet all underdrain requirements.

Each Leopold filter block is about 2 sq. ft. in area—weighs approximately 100 pounds.

Complete Water Purification and Sewage Plant Equipment . . .

- DRY CHEMICAL FEEDERS
- FILTER OPERATING TABLES
- MIXING EQUIPMENT

Want more details? Write us today.

F. B. Leopold Co., Inc.
2413 W. Carson Street
Pittsburgh 4, Pa.

Centrifugal, Turbine-Type Pumps

1119

Aurora Pump Company, Aurora, Illinois, has just published an 8-page **Condensed Catalog and Selection Guide** that presents the current line of Aurora Centrifugal and Apco Turbine-Type Pumps.

A unique selection table indicates which types of pump will meet certain capacity and head demands. Each pump is illustrated together with a statement of applications, features and individual selection tables.

Globe and Angle Values

1120

The Kennedy Valve Manufacturing Company, Elmira, N. Y., has printed a new Bulletin describing the new **Kennedy "500 Brinell"** line of **Bronze Globe and Angle Valves.**

Features of the Kennedy "500 Brinell," as described in the bulletin include seats and discs of cutlery grade, true "500 Brinell" stainless steel, precision machined on specially designed equipment. Both seat and disc are polished to a 10 micro-inch smoothness for perfect

THE FISH WHICH GOT AWAY MAY BE EXAGGERATED

BUT 2" & 2¼" CAST IRON PIPE

18 ft. LONG IS A FACT!

McWANE-PACIFIC DeLavaud

Here is Small Diameter Cast Iron Pipe as modern as a jet plane. For many years, 2" and 2¼" Cast Iron Pipe has been cast in 6', 9' or 12' lengths. McWane-Pacific DeLavaud 2" and 2¼" pipe is cast centrifugally in metal molds in *18-FOOT* laying lengths. In pipe line construction, it lays FAST, is easy to handle by two men, reduces construction costs. Furnished in bell-and-spigot or Boltite mechanical joints with complete line of fittings. Pipe and fittings may be uncoated, coated or cement lined. For complete information, wire or write McWANE CAST IRON PIPE COMPANY, Birmingham, Alabama, or PACIFIC STATES CAST IRON PIPE COMPANY, Provo, Utah. (Sales offices in principal cities.)

McWANE PACIFIC — *Lasts for Centuries*

leak-proof seal. Kennedy guarantees these seats and discs to be "bottle-tight" after abuse by pipe chips, pipe scale, silicates or carbonates.

The bulletin states that Kenalloy, the new, exclusive Kennedy valve stem material, insures trouble free service on the "500 Brinell" series. Kenalloy is powerfully inhibited against dezincification, corrosion and other common stem ailments. Another feature of the Kenalloy stem is the Higbee-Cut Acme Thread. The Higbee-Cut eliminates feather-edge ends which in ordinary valves could break off and lock the stem in the bonnet.

The Pistol-Grip handwheel on all "500 Brinell" Kennedy valves gives a firm, easy, 3-way grip on top, sides and bottom with full palm protection because the wheel nut is down inside the deep pocket. Finger-wide rib spacing combined with indented rim notches under the rim, eliminates slip even with greasy gloves.

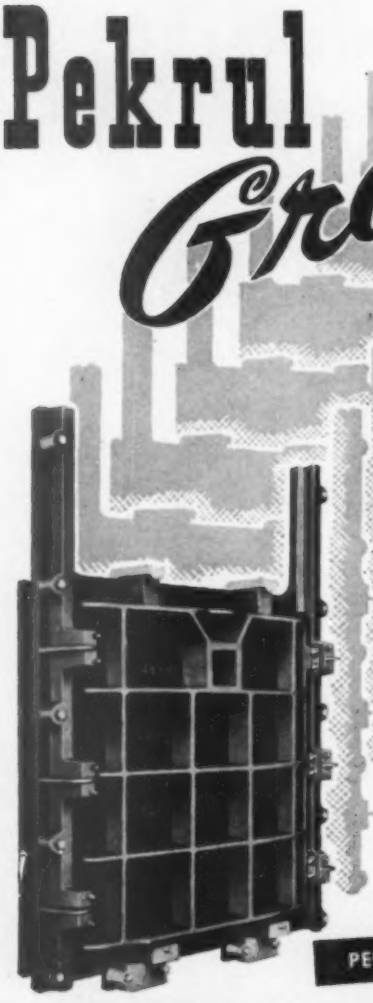
Screw Seal Clay Pipe

1121

The Robinson Clay Products Co., Akron, Ohio, has published an illustrated four-page bulletin showing special uses of **Screw-Seal Clay Pipe** for industrial installations. Robinson Screw-Seal Clay Pipe with the tough plastic joint is being used more and more widely throughout industry for acid lines, fume ducts, brine disposal and gravity water systems, and soil lines, as well as heating and ventilating systems.

According to the bulletin Screw-Seal Pipe is completely unaffected by the corrosive action of acids, gases and all commonly encountered industrial chemicals. The tough plastic joint, consisting of Phenolic collars and cast-on threads of Plastisol make a supertight, acid-resistant seal that is not only practical but easy to install. Three turns by hand and one with a strap wrench is all that is required to make a perfect joint that will give years of trouble-free service.

Pekrul Grows



To keep pace with the ever increasing demand for PEKRUL GATES over half a century, MORSE BROS. MACHINERY has just completed an extensive modernization program. The installation of many new machines and facilities, an increased engineering staff, and complete, new, custom re-tooling specifically for PEKRUL GATE production means...

modern design and superior engineering service...

even faster PEKRUL GATE deliveries to you...

PEKRUL GATE DIVISION

MORSE BROS. MACHINERY
DENVER, COLORADO

MANUFACTURERS OF PEKRUL GATES FOR

Flood Control · Sewage Disposal · Rearing Ponds · Recreation Pools
Levees · Reservoirs · Irrigation · Cooling Towers · Pumping Plants
Water Works · Oil Refineries · Steel Mills · Dams · Fish Hatcheries

LimiTorque Valve Controls

1122

Philadelphia Gear Works, Philadelphia, Pa., announced a complete new 21 page catalog, L-54, fully describing **"LimiTorque"** valve operators.

According to the catalog LimiTorque eliminates the need for manual operation of valves, and is favored for its simplicity, economy, and dependability when fully automatic operation is desired.

As the name implies, "LimiTorque" limits the amount of torque applied to valve operating parts.

This new catalog illustrates and describes the latest LimiTorque SMA valve control for large or small valves, as well as showing operational details and illustrations.

Hydrant Bulletin

1123

The Rensselaer Valve Co. of Troy, New York, has released a new 12 page bulletin on **Fire Hydrants.**

It contains a complete description with line drawings and sectional views, including sections on installation, servicing, spare parts, and extensions.

New features include illustrated descriptions of the "O" Ring Seal, and mechanical joint ends made to fit centrifugal cast, cast iron pipe and 150 Transite pipe.

Link-Belt Products

1124

Link-Belt Co., Chicago, Ill., has just published a new 340-page **Standard Products Catalog** that provides easy and rapid selection.

The products shown fall into several major classifications. These include chains and sprockets for conveying, elevating and power transmission. Tables of pre-engineered drives facilitate the selection of standard roller chain drives and silent chain drives. Complete listings are given of stock and made-to-order chains and sprockets.

The line of enclosed gear drives includes the newly developed parallel shaft helical drives in addition to herringbone, worm, and Electrofluid drives. The P.I.V. variable speed drive grouping includes 20-25 h.p. H6 units with input and output gears.

Transmission products include ball and roller bearings and incorporate listings of the new JPS light duty ball bearings and the LPK mill-type roller bearings for the heaviest applications. The broad range of other products for efficient power transmission includes babbitted bearings, pulleys, gears, clutches and couplings.

The section covering conveyor components gives a comprehensive listing of standard products for screw conveyors, belt conveyors, Flexmount oscillating conveyors and bucket elevators. A new ball bearing trolley is featured in the section on trolley conveyor components.

Stock products are readily identified and, with tables of pre-selected assemblies, will enable the purchasing agent, plant engineer and master mechanic to choose from stocks of Link-Belt equipment. These are available from Link-Belt industrial distributors in major cities and from strategically located factory branch stores or manufacturing plants.

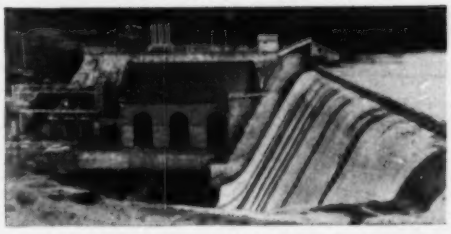
Catalog 950, with its flexible cover and thumb index, will prove to be invaluable to the engineer or layout man. Clear and concise capacity charts and dimension tables will aid in rapid selection of standard products and stock items for new installations.

Gasket Sealability and Joint Performance

1125

Johns-Manville, New York, N. Y., has just published a booklet entitled **"The Gasket"** that discusses how flange surface finishes affect

CEMENT GUN Co. RESTORES DAM with "GUNITE"



The photographs, at left, show a large Ambursen type dam in Northern New England which has been reintegrated with "GUNITE."

The top photograph shows the spalled and eroded condition of the concrete when the Cement Gun Company crews arrived on the job. The surface was chipped back to sound concrete and reinforcing mesh applied. Then the entire downstream surface was blanketed with "GUNITE."

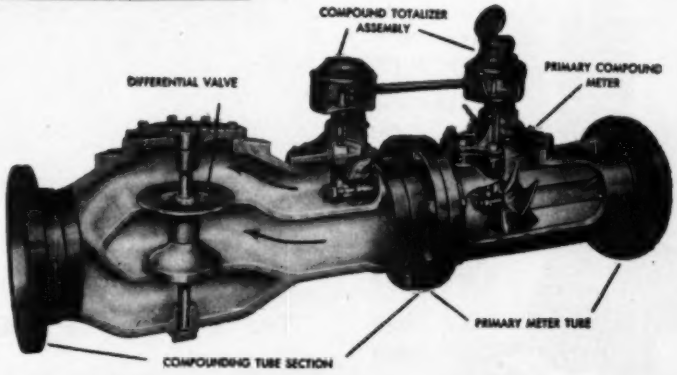
The bottom photograph shows the completed "GUNITE" surfacing of the dam.

This is typical of many dams which we have restored throughout the country. Many similar examples of repair, remodeling and new construction with "GUNITE" are described and pictured in Bulletin C2400. A request on your letterhead will bring a free copy by return mail.

CEMENT GUN COMPANY
"GUNITE" CONTRACTORS
GENERAL OFFICES – ALLENTOWN, PA., U. S. A.

MANUFACTURERS OF THE CEMENT GUN

Sparling WATER CONTROL EQUIPMENT



COMPOUNDS for Flow Ranges as Wide as 1 to 125

The standard 6-inch Sparling Meter accurately registers flows from 90 gpm to over 900 gpm. To read flows as low as 15 gpm on a 6-inch main, install the SPARLING Compound Meter shown above. Sizes 6-inch to 36-inch.

Bulletin 313 and quotations are yours for the asking

SPARLING METER COMPANY

LOS ANGELES 54 ..... Box 3277
CHICAGO 8 ..... 1500 South Western Avenue
BOSTON 8 ..... 6 Beacon Street
DALLAS 1 ..... 726 Reserve Loan Life Bldg.
KANSAS CITY 6, MO. ..... 6 E. Eleventh Street
626 Broadway ..... CINCINNATI 2
101 Park Avenue ..... NEW YORK 17
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• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

HYDRO-TITE

DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains

Economical—Effective

Over 35 Years Of Dependable Performance

HYDRAULIC DEVELOPMENT CORP.

MAIN SALES OFFICE 50 CHURCH ST., N. Y. C.

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GATE OPERATORS — PORTABLE — FOR STANDS & UNDERGROUND GATES—MOTOR TRUCK MOUNTED

PAYNE DEAN & CO.
CLINTON, CONN.

St. Louis Turbidimeter

For measuring turbidity of water. Consists of cast aluminum housing, adjustable lamp . . . two vertical wells for holding two Nessler tubes.

This apparatus comes ready to plug into 115 volt line, comes fully equipped for normal operation.

WRITE:

Phipps & Bird, Inc.

P. O. Box 2V • Richmond 5, Va.

Surer Gland Lubrication for Centrifugal Pumps

THE Z-F GREASE SEAL

Eliminates that trouble spot where shaft enters casing. Applies constant positive lubrication to packing and shaft—automatically. Excessive heat, rapid wear, leakage and scoring will disappear as the Grease Seal applies a constant flow of lubrication when pump starts until it stops—automatically. Many other advantages, too. Write for complete description and price.

ZIMMER and FRANCESCON
MOLINE, ILLINOIS

gasket sealability and joint performance.

The most recent bulletin discusses the effect of flange surface finishes upon the performance of a gasket. For those who buy, specify or design joints in which gaskets are used, the bulletin should be a definite help. It provides a basis upon which to select the flange surface finish most suitable for a given gasket. It explains why the right finish makes it easy to achieve an initial seal and obtain the best joint performance in service.

pH Bulletin

1126

The Bristol Company, Waterbury, Conn., has just published a new bulletin on **Complete Instrumentation for pH Measurement and Automatic Control.** It contains drawings and photos of installations of pH recording and controlling instruments in such processes as coagulation of the optimum pH, recarbonation, pH changes during water conditioning, pH during aeration in the activated sludge process, and pH in the acid phase of the digestion process.

The bulletin features complete pH systems, including the electrode assemblies, amplifier, and Electronic Dynamaster round- or strip-chart recorders and controllers in both pneumatic or electric control actions. The new Beckman Model W Amplifier is illustrated and detailed for the first time in conjunction with a pH recording control system.

Vertical Pumps

1127

Peerless Pump Division, Food Machinery and Chemical Corporation, Los Angeles, Calif., has just published a bulletin on **Hydro-Line Pumps** to describe and illustrate these two types of vertical, encased, close-coupled pumps.

In addition to explaining the importance of the wide application flexibility, space-saving qualities and excellent NPSH (net positive suction head) characteristics of encased, vertical, close-coupled pumps, the bulletin completely documents and illustrates the many construction features of both a process type vertical pump and a transfer type vertical pump and points out where each may be advantageously and profitably applied.

Activated Sludge Plants

1128

Walker Process Equipment Inc., Aurora, Illinois, has just published a new bulletin on **Package Activated Sludge Plants.**

The bulletin contains complete description, general specifications and suggested plans for small sewage treatment plants to serve population equivalents of 1000, 1500 and 2000. The Package Plants are especially suitable for industrial installations, housing developments, resorts and small communities.

Dorrco Hydro-Softener

1129

The Dorr Company, Stamford. Conn., has announced the availability of a new four-page, two-color bulletin, "The Dorrco Hydro-Softener." It includes a description of the physical characteristics, sizes and capacities, operation, advantages, and applications of this new continuous water softener and cites operating data from a municipal installation. Illustrations include a graphic wash drawing and photograph of the Hydro-Softener and its basic components.

According to the bulletin the Dorrco Hydro-Softener is the first continuous base exchange type softener to be offered commercially. Continuous regeneration of expended resin in a separate column eliminates the need of periodic shutdowns as in conventional batch units. Basically it consists of two elements—a two compartment softening cell and a five compartment regeneration cell. Panel mounted controls provide for regulation and measurement of resin transfer, regenerating brine, and wash water flows.

Packings and Gaskets

1130

Johns-Manville, New York, N. Y., has just published a 6-page illustrated folder on **Chempac Packings and Gaskets.** These various Chempac materials, which are virtually unaffected by corrosive chemicals and active solvents, are made of asbestos treated with Teflon.

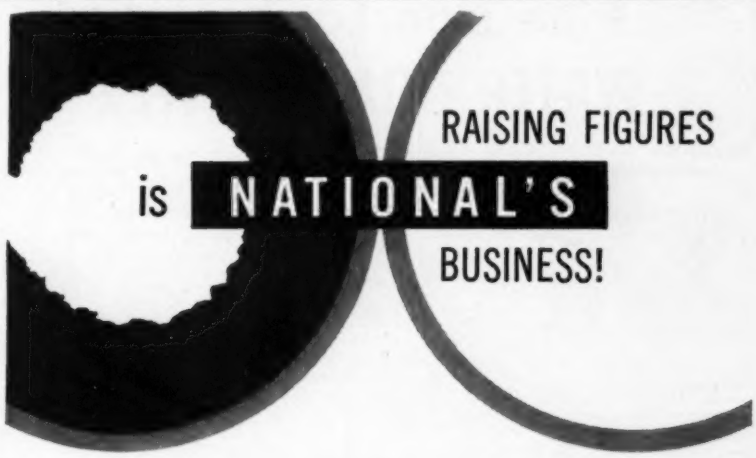
The folder gives pertinent information on each of the several types. These include Chempac Interlocked Packings, a braided material offered in two styles; Chempac Packings in coil, spiral and ring forms which are offered in four styles; general purpose Chempac Gaskets offered in two styles; Chempac Folded Gaskets for glass lined equipment offered in two styles; and, Chempac Spirotallic Flange Gaskets (made of Teflon-treated asbestos and stainless alloys) for high pressure service. The folder also carries information on solid Teflon sheets.

Hypochlorination of Water

1131

Mathieson Chemical Corp., Baltimore, Maryland, has available a recently revised edition of the 50-page booklet **Hypochlorination of Water.**

This attractive, well illustrated booklet is a veritable handbook on water hypochlorination. Some of the major chapter headings are: The treatment of water supplies; Chlorinating for safety; Sterilizing new equipment; Chlorination practices; Emergency conditions; Control of algae and tastes and odors; HTH dosage tables; Analytical determinations; etc. A series of 8 tables are included and a complete list of water treating chemicals made by Mathieson.



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Storage Tank Catalog

1132

Hammond Iron Works, New York, N. Y., has just published a data book dealing with **Storage Tanks** and steel plate fabrication. The catalog features material specifications, tank design data, foundation recommendations, accessories and fittings, computing tables for size and capacity, welding procedures, testing methods and information on all types of storage tanks and general steel plate construction.

Illustrated are examples of every type of storage tank designed and erected by Hammond Iron Works, including: cone roof, Dialift, Diaflote, floating roof, Vapor-lift, sphere, irregular shaped tanks for above and below ground, steel dikes, standpipes and elevated water tanks as well as vessels and steel plate fabrication.

Water Jet Eductors

1133

Schutte and Koerting Company, Cornwells Heights, Penna., has just released a bulletin that describes the complete line of **SK Water Jet Eductors.**

This 36-page, 3-color bulletin discusses in detail standard and special SK Water Jet Eductors. Included is comprehensive information on design, construction, application and operation. Also contained is valuable material on methods of pumping and moving liquids, and handling solids with SK Eductors.

A special feature of the bulletin is a Nomograph which permits the reader to determine whether or not a special SK Eductor might be applicable where a standard Eductor will not do the job.

The SK Water Jet Eductors described in Bulletin 2-M are widely applied in the lifting, pumping, mixing and agitating of liquids, and in the handling of solids and slurries.

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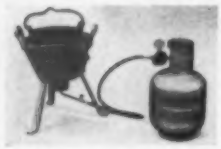

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On Making Mistakes

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Looking for Something Soft?

The fellow who goes through life looking for something soft can generally find it right under his hat.

Small Package

A man wrapped up in himself is usually a very small bundle.—Ben Franklin.

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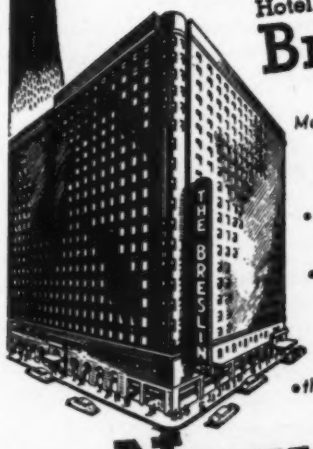

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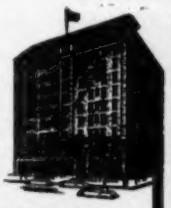

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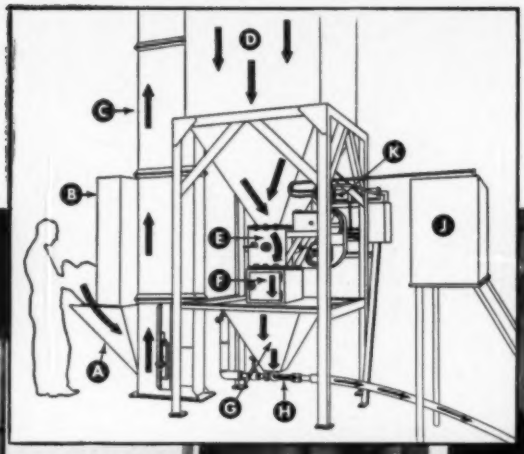
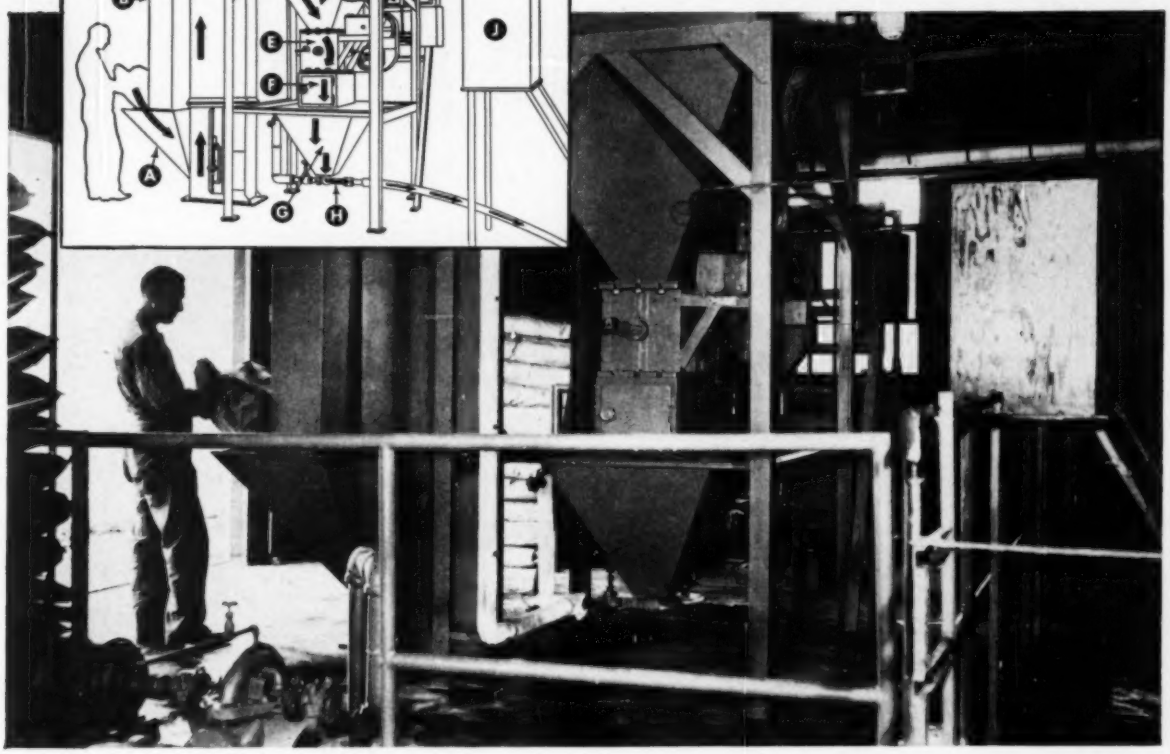
Zimmer & Francescon 110A

*Advertisers represented in the May, 1954 Reference and Data Edition with Catalog specifications copy. Please refer to that issue for additional information concerning their products or equipment.



Omega Continuous Chemical Feeding System includes: (A) loading hopper, (B) dust collector, (C) bucket elevator, (D) storage hopper with low level alarm, (E) Rotolock Feeder, (F) inspection chute, (G) dissolving chamber, (H) ejector for delivering chemical solution to raw waste channel, (J) pH controller, and (K) pneumatic positioner for varying feed rate in proportion to pH.



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